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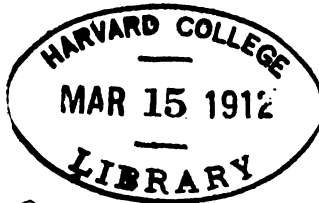
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KEY TO PRONUNCIATION.

ā	far, father	ñ	Span. <i>ñ</i> , as in <i>cañon</i> (cān'yōn), <i>piñon</i> (pēn'yōn)
ā	fate, hate	ng	mingle, singing
a or ă	at, fat	nk	bank, ink
ā	air, care	ō	no, open
ā	ado, sofa	o or ō	nct, on
ā	all, fall	ô	corn, nor
ch	choose, church	ô	atom, symbol
ē	eel, we	o	book, look
e or ě	bed, end	oi	oil, soil; also Ger. <i>eu</i> , as in <i>benteu</i>
é	her, over: also Fr. <i>e</i> , as in <i>de</i> ; <i>eu</i> , as in <i>neuf</i> ; and <i>oeu</i> , as in <i>boeuf</i> , <i>coeur</i> ; Ger. <i>ö</i> (or <i>oe</i>), as in <i>ökonomie</i> .	ō or oo	fool, rule
ę	befall, elope	ou or ow	allow, bowsprit
ē	agent, trident	s	satisfy, sauce
ff	off, trough	sh	show, sure
g	gas, get	th	thick, thin
gw	anguish, guava	th	father, thither
h	hat, hot	ū	mute, use
h or ɣ	Ger. <i>ch</i> , as in <i>nicht</i> , <i>wacht</i>	u or ũ	but, us
hw	what	ū	pull, put
i	file, ice	ū	between u and e, as in Fr. <i>sur</i> . Ger. <i>Müller</i>
i or ī	him, it	v	of, very
i	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din	y	(consonantal) yes, young
j	gem, genius	z	pleasant, rose
kw	quaint, quite	zh	azure, pleasure
ñ	Fr. nasal <i>m</i> or <i>n</i> , as in <i>embonpoint</i> , <i>Jean</i> , <i>temps</i>	' (prime), " (secondary)	accents, to indicate syllabic stress

THE AMERICANA

Public Parks. This term is applied to any space, whatever its area, maintained by municipal, state, or Federal management as a public recreation place. Public parks vary in size from the small square or triangular enclosure at intersections of streets to such huge reservations as Yellowstone Park in the United States. Some of the most famous public parks are Hyde Park in London, Central Park in New York, Fairmount Park in Philadelphia, and the Promenades and Gardens of Paris.

Public parks are of very ancient origin. Egypt, Assyria, Persia, Greece, and Rome had them in one form or another. In the earlier Middle Ages, with the decay of cities and the general neglect of the amenities of civilized life, public parks received no special attention. Indeed, they were not needed. In more modern times, however, every country has prided itself on one or more of its large parks, and every city has numbers of "squares."

Formerly the forest-like park, out of the way and often remote from a given centre of population, was much desired. London has such parks still, and Fairmount Park and Yellowstone Park are two American models of forest-like parks. Paris, on the other hand, abounds in parks that are nearer or at the centre of the city; Central Park in New York is a typical American model of parks where the people want them.

Of smaller parks there is no end. These are usually municipal parks, and are increasing in number yearly. Frequently a city buys a lot of ground and converts it into a beautiful resting place where grass and flowers attract women and children. Sometimes, too, as in New York, playgrounds are also provided. See PARKS AND PARKMAKING.

Publicola, püb-lik'ō-la, **Publius Valerius**, Roman consul and general: d. between 503 and 496 B.C. He is stated to have been a descendant of a noble Roman family and was present when Lucretia stabbed herself. He was instrumental in the expulsion of the Tarquins, and when Collatinus was forced to resign Valerius was elected consul in his stead in conjunction with Junius Brutus. When the Tarquins, aided by the Veientes, moved against Rome in 509 B.C. they were met by the Romans under the two consuls and defeated. Brutus fell in the battle leaving Valerius sole consul. On the return of Valerius to Rome he began the erection of a home on the Velian hill, but perceiving that the people suspected him of a desire to raise himself to royal power he had the building destroyed and his lictors were ordered to lower their fasces when they appeared before the people. He promulgated a law by which any person who attempted to usurp kingly power might be killed by any one, and another establishing the right of a plebeian condemned by a magistrate to appeal to the people. In recognition of his services he received the surname Publicola, "the people's friend." He was three times re-elected consul, conducted the expedition of Porsena, and with his colleague Titus Lucretius Tricipitinus de-

feated the Sabines in 504. His death is placed by some in the following year, but Niebuhr thinks that he died in the battle at Lake Regillus in 498 or 496. Consult: Niebuhr, 'History of Rome,' Vol. I.; Cicero, 'De Republica.'

Publishing. See AMERICAN PUBLISHING; BOOK.

Puck, in mediæval mythology, a celebrated fairy whose character and attributes are depicted in Shakespeare's 'Midsummer Night's Dream.' This fairy is known by a variety of names, as Robin Goodfellow and Friar Rush in England, and in Germany as Knecht Ruprecht; but it is by his designation of Puck that he is most generally known in England, Germany, and the more northern nations. He was the chief of the domestic tribe of fairies, or "brownies," as they are called in Scotland; and innumerable stories are told of his nocturnal exploits.

Pud. See POOD.

Pudding-berries, the berries of the Canadian dogwood (*Cornus canadensis*), common throughout North America. See DOGWOOD.

Puddingstone. See CONGLOMERATE.

Puebla, La, lä pwäb'lä, Mexico, a State of the Republic and its capital city. The State of La Puebla in the central plateau of the Anahuac has Vera Cruz to the north and west of it, Oaxaca to the south, Guerrero to the southwest, and Morelos, Mexico, Tlaxcala, and Hidalgo to the west. See MEXICO—STATE OF.

Puebla, Mexico, (originally called Puebla de los Angeles), capital of the State of the same name; 116 miles east of the City of Mexico by the Mexican railway, but considerably less than 100 miles in a straight line; altitude over 7,000 feet above the sea. The climate is most agreeable, the maximum temperature being 84° in summer and 75° in winter. The peaks Popocatepetl and Ixtaccihuatl are only about 25 miles distant, and those of Orizaba and Malinche are in plain view. Three steam railways,—the Mexican, the Mexican Southern and the Inter-oceanic, and a street railway which will soon be electrified, supply transportation. Straw hats, leather goods and numerous other articles are manufactured in considerable quantities, and in the immediate vicinity are several large cotton mills. Near by are the famous onyx quarries which have for many years supplied great quantities of beautiful onyx to Mexico and the United States. A manufactory in the city makes of the product of these quarries an endless variety of useful or ornamental objects, from store and saloon fixtures, table tops and wash basins to imitations of every fruit known in the country. The banking facilities of the city are supplied by the Oriental Bank, with \$6,000,000 capital, and branches of the National Bank and Bank of London & Mexico, of Mexico City. The city is noted for its many churches, clean streets, substantial business edifices and grand Cathedral, which was almost 150 years in building, is 323 feet long, 101 feet wide and 80 feet from floor to roof.

PUEBLO — PUEBLO INDIANS

The educational institutions besides the Primary and High Schools, are the State College, School of Medicine, Normal School for Men, Norma School for Women, Normal School of Arts, Academy for Belles Arts, and Hospicio for the education of children. There are three public libraries with a total of 78,000 volumes, a museum of archæology, an art gallery, an observatory, a market hall, sulphur baths, a general hospital founded in 1658, and a maternity hospital, state hospital for both sexes, hospital for the insane, children's hospital, military hospital, Interceanic Railway Hospital and Spanish Beneficiary Hospital. The Palace of the state government, which was recently greatly extended and improved and which faces the principal park or zocalo is one of the notable buildings of the city. The extensive and very beautiful Alameda is a most attractive spot, and contains a monument erected in 1898 in honor of Mexico's liberators, and the monument to General Nicolas Bravo. There are also the French-Mexican monument erected by the French colony in 1902, and the equestrienne statue of General Zaragoza, which surmounts a fine monument erected at the foot of the hill of Guadalupe. In the Government Palace is a most interesting collection of historic paintings and a library of 28,000 volumes. The zocalo or central park of the city is artistically laid out in vine and foliage covered walks, with fountains and statues here and there, and numerous small plazas supply needed breathing spots. There are two theatres. Since 1532, in which year the royal sanction was given to form a settlement here, Puebla has occupied second place among all the cities of the land, commercially, spiritually and in population, until very recently, when Guadalajara forged ahead in population and material development generally.

The city of Puebla was founded in 1532 by the Franciscans, and is considered the military key to the capital of the republic. It was captured by the French in 1863 and recovered by the Republican forces under General (now President) Diaz, in 1867. Tradition asserts that when Cortez came he found a city of 300,000 inhabitants, 400 temples and a legion of priests, six miles distant from Puebla, where now is the famous Pyramid of Cholula; and that the Aztecs came there in great numbers to worship and offer up human sacrifices. Pop. about 100,000.

Pueblo, pwëb'lô, Colo., city, county-seat of Pueblo County; on both sides of the Arkansas River, at the mouth of Fountain Creek, and on the Atchison, T. & S. F., the Colorado & S., the Denver & R. G., the Missouri Pacific, and the Chicago, R. I. & P. R. R.'s; about 122 miles south by east of Denver. Within its corporate limits are several villages: North Pueblo, Central Pueblo, South Pueblo, and Bessemer. It is in a basin on the eastern foot-hills of the Rocky Mountains. A temporary Mormon settlement was located here in 1846, and a trading post was established in 1850. In 1854 the Ute Indians massacred the residents of the post. In 1859 the present city was laid out, and in 1873 it was chartered as a city. The region of country east is largely devoted to agriculture and stock raising. In the vicinity of the city

are extensive coal and oil fields, and deposits of limestone and iron ore. The silver and copper ores are brought a considerable distance to the smelters of Pueblo; and lead, gold, and zinc are here prepared for the metals of commerce. The iron and steel industries have become quite extensive. The Colorado Fuel and Iron Company (steel plant) have (1904) 6,300 employees; the railroad car-shops and yards, 2,500 employees; the smelters, 3,200; the foundries and other manufactories, 6,000. In 1903 there was invested in manufacturing industries, a capital of about \$13,000,000, and the products were about \$32,000,000, of which amount nearly two thirds was the product of the lead smelting and refining.

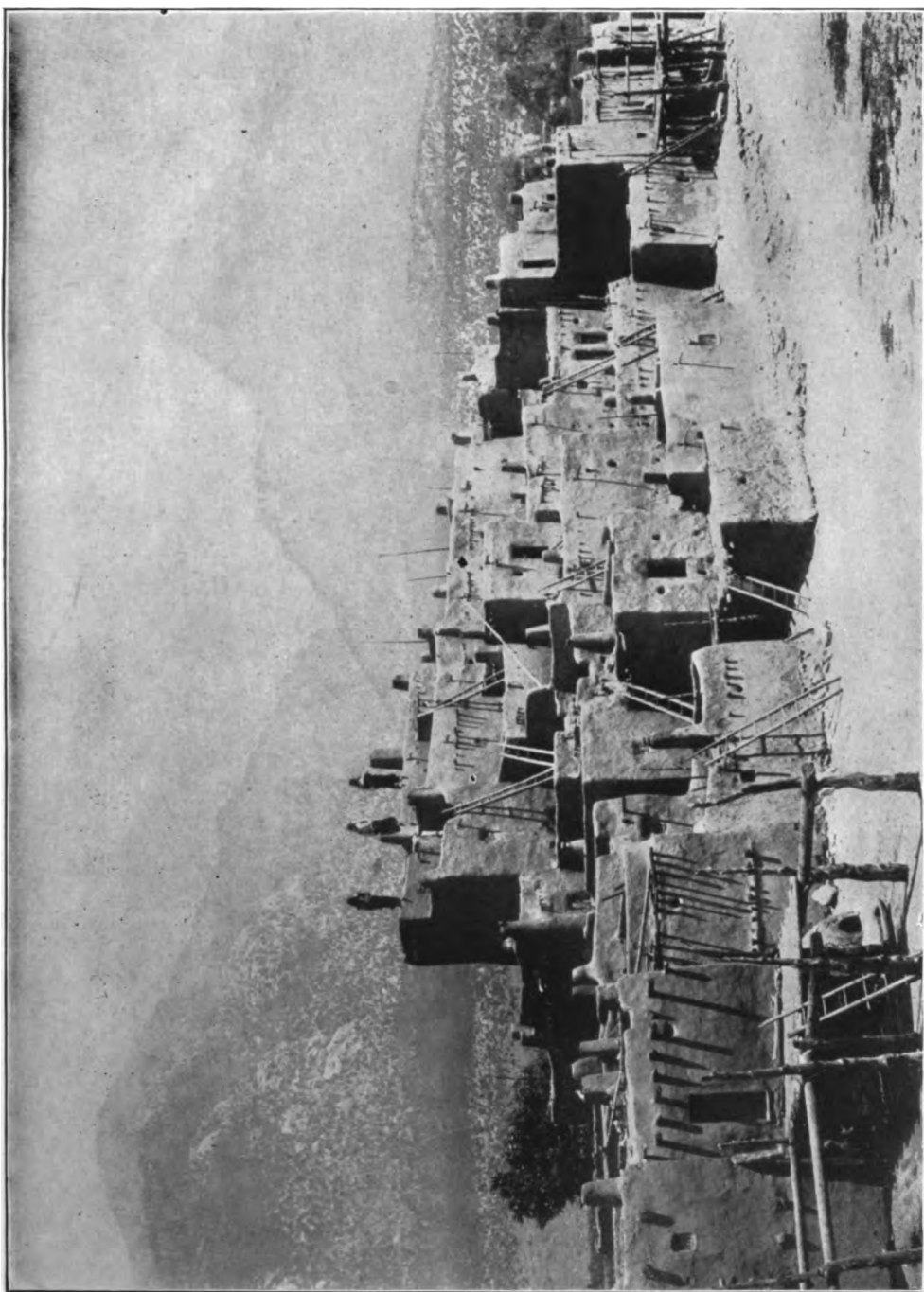
The principal public institutions are the State Insane Asylum, Saint Mary's Hospital and Sanatorium (1,000 patients annually), Minnieque Hospital (cost \$300,000), and small private sanatoriums. There are two systems of public schools, one on each side of the river; two high schools, public and parish schools (14,000 school children), Loretto Academy, the McClellan public library with 14,000 volumes, law libraries, school libraries, and the State Mineral Palace and Park. A complete collection of the minerals of Colorado are in the Mineral Palace. The five banks have a combined capital of \$800,000 and deposits of \$10,000,000. The government is administered under a charter of 1887 which provides for a mayor who holds office two years, and a council of eight members. The council confirms the mayor's appointments and elects the police judge, city physician, and the members of the fire department. The treasurer, clerk, engineer, and auditor are elected by the people. The city owns and operates one system of waterworks, and another is owned by a private corporation. The large majority of the population are native-born Americans; about 2,000 are Italians; 1,000 are Austrians, and 1,500 are colored. Pop. (1890) 24,558; (1900) 28,157; (1910) 44,395, an increase during the last decade of 57.7 per cent.

E. W. POERRE,

Secretary Business Men's Association.

Pueblo Indians (Spanish, "town," "village"; hence Pueblos, "villagers"), a group of sedentary agricultural tribes comprising the Tanoan, Keresan or Queres, and Zuñian linguistic stocks in New Mexico, and the Hopi or Moqui of the Shoshonean stock in northeastern Arizona. There are also some Mexicanized remnants of the Tanoan stock on the Rio Grande below El Paso, in Texas, and Chihuahua. For details see under the above stock names.

Physical Characters.—Disregarding those who have been more or less affected by Spanish contact, the Pueblo Indians are generally small in stature, particularly the women, some of whom are quite diminutive. After marriage the latter frequently become stout, but obesity is rare. The men are a rich brown in color, not so dark nor so reddish as their Navaho neighbors. The women are lighter, many of them being of a fine olive tint, which, with regular features and often with eyes almost oriental in type, make them decidedly comely. Albinism is common among the Hopis and Zuñis, those of the latter tribe averaging one in 200. The hair is thick,



PUEBLO INDIAN VILLAGE.

PUEBLO INDIANS

black, and glossy. That of the men is cut "terrace fashion," that is, banged across the forehead, cut horizontally at the sides on a line with the chin, and allowed to grow to full length behind, but knotted and tied into a short queue. This is probably the more primitive style of hair dressing, but it now varies more or less with the tribe. The front hair of the women is cut level with the chin, parted laterally, and allowed to fall over the face, necessitating continual brushing aside with the hand to permit them to see. The unmarried Hopi girls retain the primitive method of wearing the hair, after reaching puberty, in large whorls over the ears.

Dress.—The costume of the men, now largely superseded by the clothing of civilization, consisted of a shirt, a poncho-like coat formed of a squarish piece with a hole in the middle for the head, and sewed down the sides, with partly open sleeves; a pair of loose trousers reaching below the knees, open half-way up the outer sides and fastened with a belt; footless stockings, leggings, garters, moccasins or sandals, breechcloth, headband, hairband, and blanket. Dressed skin or native cotton formed the chief materials from which their costumes were made, but these gave place largely to woolen articles after the introduction of sheep by the Spaniards. The woolen blanket of later times was probably preceded by a robe made of strips of rabbit or wildcat skin coarsely woven or plaited together. Yucca strips, feathers, and even human hair also formed raw materials for clothing. The typical dress of the women consisted of a skirt of skin or cotton (now of wool) reaching from the neck to below the knees, and girded with a belt, the right arm and shoulder being bare; a manta hanging loosely from the neck and down behind or thrown over the head; stockings, buckskin leggings, consisting usually of an entire skin wrapped many times around the calf, and sandals or moccasins, to which latter the leggings were attached. Among some of the Rio Grande Pueblos the women wear soft buckskin boots instead of the cumbersome leg-wrappings. Necklaces of seashell and turquoise beads and pendants, ear-tablets, bracelets, and other ornaments were worn by both men and women, but the shell necklaces of the latter have been superseded by those of silver. Leather belts strung with large silver disks and silver-mounted wristguards are now worn by the men who can afford them. Excepting the moccasins and leggings, skin has largely passed out of use for clothing, cheap cotton prints and a woolen blanket being almost exclusively employed by the men.

Houses.—The typical pueblo is a many-celled, communal, defensive structure of several stories, opening on one or more courts or plazas in which dances and other ceremonies are performed. When the pueblo enclosed a single court, the outer wall was usually the highest, and was pierced with only small openings, or port-holes, to afford a view of the surrounding country. A slight elevation was usually preferred, but there are many instances in which the site is a lofty mesa or a level plain, while other dwellings were built in natural recesses in the rocky walls of cañons or cliffs, hence their popular designation, *cliff-dwellings*. The site therefore depended on accessibility to water, to cultivable fields, or to the necessity for de-

fense against enemies. Both rounded or polygonal structures were common, while some pueblos were semicircular in ground-plan, with a high rear wall and with the houses arranged in terraces, the tiers of dwellings successively retreating so that the roof of the lower formed the means of access as well as the "front yard" of the tier next above, and so on to the sixth or seventh story. The ground tier usually contained only small wall openings, access being gained by means of a movable ladder to the roof, which was provided with a hatchway. Most of the pueblos still follow this ancient form, but there are now but few whose ground-floor houses are not provided with doors and windows. Sometimes forming a part of and sometimes detached from the main house cluster, are chambers, wholly or partly under ground and usually circular, used as gathering places and sleeping apartments by the men, and still employed for ceremonies and tribal councils. The fireplace was in the centre, the smoke escaping through the hatchway; so hot did these *kivas* become that the Spaniards likened them to stoves, hence their still popular name, "estufas." The structural materials depended largely on the immediate supply. Slabs of sandstone being abundant, were commonly used; they were sometimes neatly pecked and laid in adobe mortar or chinked with spalls, and although joints in the masonry were not "broken," the result was frequently a marvelously straight and strong wall that has stood the ravages of centuries. *Pisé* construction was also employed in massive buildings, such as Casa Grande in southern Arizona. Molded adobe bricks, now so commonly used, were not made in pre-Spanish times, but balls of mud mixed with ashes and sage, and dried, were in vogue as a building material in prehistoric times. The roofs of the houses consist usually of pine or cottonwood beams, with light poles laid transversely, which in turn were covered with brush-grass, and adobe mud, well tamped. The introduction of the horse, which permitted the transportation of heavy roof beams, seems to have had a decided influence in increasing the size of the rooms, the compartments of the ancient structures being usually mere cells. Flakes of selenite were pieced together for window panes, but these have given way to stock frames purchased from the white traders, while the corner fireplace and chimney have been substituted for the central fire pit, except in the *kivas*.

Industries.—As they are sedentary tribes, the Pueblos are agriculturists, their principal crops being corn, squashes, beans, and onions, to which were added wheat, watermelons, cantaloupes, grapes, peaches, etc., on the advent of the Spaniards. Corn is prepared in very many ways, and wild fruits form a not unimportant part of the Pueblo pabulum. Their meat supply was gained mainly through communal hunting, the mountains supplying bear, deer, antelope, and elk, while the valleys and cañons abounded in jack-rabbits, cottontails, prairie-dogs, wild turkeys, quails, doves, etc. The buffalo was probably hunted to some extent by the Rio Grande Pueblos, who also conducted a brisk trade with the Plains tribes up to 25 years ago. For religious reasons, fish was probably universally tabooed, water, on which everything depends, being a sacred element. The turkey was domesticated,

PUERPERAL ECLAMPSIA

and eagles were and still are kept in captivity for their feathers. Cattle, sheep, goats, horses, and asses, which now form such an important part in the Pueblo economy, were unknown before the Spaniards went among them. The Pueblos are a provident people, their reserve food supply usually being sufficient for a year's use, thus succoring them in event of drought. Most of their agriculture is conducted by means of irrigation, although patches of corn, melons, squashes, etc., and small peach orchards are otherwise successfully cultivated in favorable localities. The Hopis raised large quantities of cotton, which they wove into garments and traded with other tribes; indeed they are still the leading cotton weavers among the Pueblos, the industry probably having been introduced by clans from the far south. The Hopis and Zuñis also weave excellent blankets, sashes, dresses, garters, etc., of wool, and a few of the Zuñi men are expert silversmiths. The basket trays of the Hopis are noteworthy, although the art has greatly declined since the introduction of aniline dyes. Some of the other Pueblos make a coarse basket for domestic use. As potters the Pueblos are far in advance of all other Indians north of Mexico: purely primitive methods are still employed and the decorative motive is generally symbolic, intricate, and pleasing.

Social and Religious.—All the Pueblo tribes are composed of numerous clans, named after some animal, plant, or other natural object, and grouped into phratries. Maternal descent is recognized, that is, the children belong to the clan of the mother. Marriage, which is not allowed between members of the same clan, is generally effected by mutual consent of the contracting couple and their parents, and is sealed after an exchange of gifts and a simple primitive ceremony; the vow, however, is not very binding, and divorce is merely a matter of mutual agreement, the offspring, if any, invariably belonging to the mother. The status of the Pueblo woman is high; she owns the house and its furniture, while it is the husband's duty to provide for his family and he frequently makes his wife's clothes. The dead were formerly buried in the houses or beyond the house walls, according to the priestly standing of the deceased; now, however, the dead are buried in a common cemetery in front of the Catholic Church, except among the Hopis, who deposit their dead in crevices in the rocks. The social and religious organization of most of the Pueblos was considerably affected by the Spanish missionary and civil authorities, and among all the tribes except the Hopis a civil governor and other officers are now annually elected, although their power in some instances is only nominal. Originally the religious and social organization was inseparable: each clan had its priest or priest-chief, while both the internal and the external affairs of the tribe, where they affected the complicated and far-reaching religious organization, were controlled by a priesthood. There were also other socio-religious societies, grouped according to the several regions—north, south, east, west, upper, and lower—some of which assumed control over certain affairs in winter, others in summer. The members of these societies, where they still exist, are the medicine-men of the tribe, some of whose functions are the prevention as well as the cure of disease, the regulation of the communal

hunts, the extermination of witchcraft, etc., and the intermediation between the tribesmen and the many nature gods which form the Pueblo pantheon. Communication with these nature powers was and is still conducted by means of secret or open ceremonies, consisting of the depositing of prayer-sticks, chants, dances, sacrifices, pantomime, masquerade, the recital of rituals, etc.

History.—From the Pueblo tribes which have been more intimately studied it has been learned that they consist of many small accretions from various stocks and from many localities, which left their former homes on account of drought and the consequent failure of crops, through superstition, the depredations of enemies, etc. The migrations of these component clans or parts of clans were sometimes very slow, many years being consumed in their journeyings and village after village being successively built, occupied, and abandoned before the final settlement was made. Thus are many of the ruins of Arizona, New Mexico, Colorado, and Utah accounted for. The nuclei of the various Pueblo tribes, however, had their traditional origin in the north, at a place called Sipapu, where they are supposed to return after death, and which is symbolically represented by an opening in the floor of the ceremonial chambers, in front of the altars erected during religious rites.

Indefinite knowledge of a populous region in the north was gained by the Spaniards in Mexico early in the 16th century, and led first to the journey in 1539 of Fray Marcos de Niza to the "Seven Cities of Cibola," the present Zuñi, followed a year later by the expedition under Coronado. This was the first direct contact of the Pueblo Indians with the whites. For the successive Spanish expeditions and the later history of the Pueblos, see *NEW MEXICO*, and also the subjects mentioned below.

Population.—At the time of Coronado's visit the Pueblo tribes were said to inhabit 66 villages and to number 20,000 men, but it is doubtful if the entire population exceeded this estimate. With the exception of Acoma and Isleta none of the 28 pueblos now existing occupy their 16th century sites, the remainder having been forced into new locations chiefly during the reconquest of New Mexico after the Pueblo revolt of 1680. The present aggregate population of the 28 villages is 10,259. For their distribution see *QUERES*, *SHOSHONEAN*, *TANOAN*, and *ZUÑIAN*.

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Puerperal Eclampsia, a form of eclampsia occurring in pregnant women, usually arising from blood-poisoning and often fatal. The exciting causes may be many, but some form of increased irritability of the nervous system is one of the most important features of the condition. The symptoms come on suddenly, or following a headache, with irritability, and perhaps slight impairment of sight or hearing, or with vomiting. Convulsions of an epileptic, hysterical, or apoplectic variety constitute the main symptom. These convulsions may last for from one to five minutes, and are usually accompanied by unconsciousness. They recur sometimes at very short intervals, most frequently hourly, and many vary from 10 to 30 or more in a day. Such convulsive seizures are always serious to

PUERPERAL FEVER—PUERTO PRINCIPE

both mother and child, and prompt emptying of the uterus is the main remedy to be employed.

Puerperal Fever, an infectious disease of women occurring shortly after childbirth, or following a miscarriage, accidental or induced. It is caused by a micro-organism, usually a bacterium (*Streptococcus*), and is communicated by contact with unclean hands, instruments, or clothing which may have brought the infection, just before, during, or after the birth of the fœtus. Only in the rarest of instances does it occur when due precautions as to absolute surgical cleanliness have been observed. It usually begins within a week after the termination of pregnancy, ordinarily from the third to fifth day, and is attended with acute inflammation of the reproductive organs, and with septic infection of the blood and body at large. It is always an infection from without, and is preventable by rigid aseptic midwifery. The symptoms will vary very widely according to the infecting organism and the severity of the infection. A slight amount of fever and some local extension of tenderness may be the only symptoms present in mild cases. In septicæmic cases there is usually a decided chill about the third or fourth day, and is attended with acute inflammation of 102°, 103°, 104°, 105° F. with general depression and rapid pulse. The temperature usually remains high and then suddenly drops as the patient recovers. In the severest cases, the pyæmic infections, the blood-current becomes infected; chills, temperature, sweats, occur and recur, and the patient usually dies. The treatment is purely medical, sometimes surgical, and needs the skilled physician and nurse. Prevention is the demand of the modern woman, and she is entitled to it. Unskilled and dirty midwives, unclean doctors, and abortionists are responsible for practically all of the deaths due to childbed fever.

Puerto Cabello, pwâr'tô kâ-bêl'yô, Venezuela, port and capital of the state of Carabobo, on a low peninsula jutting into the Caribbean Sea and forming one of the finest harbors in the world. A lighthouse and fortifications protect the entry. Railroads connect the city with Valencia, 22 miles southeast, and with Caracas, 78 miles east. German commercial interests here are strong. The exports are coffee (six sevenths of the whole), cacao, skins, cinchona, oxen, sugar, cotton, and some copper ore. The city was the last stronghold of the Spanish (1823); it was blockaded by the German and British fleets in 1902-3, as the most valuable port of entry and the best place to collect their claims on Venezuela. Pop. (est.) 14,000.

Puerto La Mar, lâ mâr. See COBIJA.

Puerto Plata, plâ'tâ, Santo Domingo, port of the Dominican Republic on the north side of the island of Haiti. The entrance to the harbor is extremely narrow; steamship lines connect with Europe, Saint Thomas and Havana, and it is connected by rail with Santiago de los Caballeros.

Industries.—Puerto Plata is the export town of the rich tobacco, sugar, and coffee plantations in the interior of the island, and the annual trade amounts to \$1,500,000. There are several valuable coal mines nearby and there is also an extensive trade in mahogany.

Public Buildings, etc.—A white cheesebox

fort, a relic of the buccaneers, situated upon a small promontory, is the only defense of the town. On one side is the new jail, on the other the barracks. There is the Commercial Club, for the older people, which has a library of 1,000 volumes, and the young men and young women have clubs, occupying commodious buildings. The houses are of modern wood and galvanized iron construction, neatly painted; the streets are straight, clean, macadamized and curbed; and the sidewalks are of stone flagging.

Schools.—The school system is modern and consists of two kindergartens, in charge of trained teachers, two boys' and two girls' primary schools, two normal schools and 15 private schools, assisted by the municipality, some of them teaching English and all planned to do so.

Government.—Municipal authority is vested in a mayor and common council, elected by the people, the mayor being president of the council. The city has a police department, a school board, and is the only city on the island having a street cleaning department; it is well lighted and has waterworks. The city debt is but \$5,000; the annual budget is about \$40,000, of which one third is spent for education.

History, Population, etc.—The town was settled in the first decade of the 16th century by Spaniards. About 30 per cent of the population speak English.

Puerto Principe, prên'sê-pâ, Cuba, (1) town, capital of the province of Puerto Principe; 170 miles northwest of the city of Santiago de Cuba. It was originally founded in 1515 at Nuevitas, the site of an old Indian village, on the northern coast, but was moved to its present site in 1516. For a time after 1800 it was the seat of government for the Spanish West Indies, and until the end of Spanish rule was an important military post. It is the largest inland city of the island, and is connected with its port, Nuevitas, by railroad. It is the centre of a cattle-raising district, and exports cattle, hides, etc.; sugar also is cultivated somewhat in the vicinity and exported. The town is very mediæval in appearance, the streets are narrow, and the houses old; during the American occupation artesian wells were bored to obtain a pure water supply, the streets were repaired, a good drainage system introduced, and buildings for schools remodeled.

(2) Province, east of the centre of the island, bounded on the east by Santiago de Cuba, and on the west by Santa Clara; area 11,000 square miles. The north of the province is mountainous, the most of the surface being high tableland affording excellent pasturage. The chief industry is cattle raising, which though it deteriorated during the war, is being rapidly revived, and the number of cattle largely increased; the finest horses on the island are also raised here. The province is also well wooded, and lumbering is an important industry; the minerals include iron, copper, and asphalt, all of which are mined to some extent, asphalt being of the most commercial importance. General agriculture is carried on mostly in the vicinity of the town of Puerto Principe, and its port, Nuevitas; sugar is the most important agricultural product. The province was a centre of the insurrectionary movement, and Cubitas in the northern part was the seat of the insurgent government in 1896-8. Puerto Prin-

cipe is the second province of Cuba in size but is least densely populated.

Puerto Real, rā-äl', Spain, a seaport in the province of Cadiz; on the Bay of Cadiz; seven miles east of the city of Cadiz. The greater part of the town is modern, on the site of Portus Gaditanus, an old Roman place. It has considerable manufacturing; the chief products are leather, pottery, linen goods, cements, vermicelli, and starch. It has a good harbor and an extensive trade; the chief exports are salt, fruit, and manufactures.

Puerto Rico, rē'kō. See PORTO RICO.

Puerto de Santa Maria, dā sän'tä mä-rē'ä (PORT SAINT MARY), Spain, city in Andalusia, in the province of Cadiz and seven miles northeast of the city of Cadiz; on the Guadalete, near its mouth in the Bay of Cadiz. It is on the railway from Seville to Cadiz. It has a town-house; theatre; a bull-ring, where was given the grand bull-fight to the Duke of Wellington, described by Lord Byron; five promenades, one of them planted with orange and other trees; infantry and cavalry barracks; a custom-house, a good edifice near the mole; a court-house; a parish church in the Gothic style; etc. Leather, soap, hats, wines, liqueurs, etc., are manufactured, and some fishing is carried on. This is one of the Spanish ports from which sherry is exported. Its vicinity to Cadiz, the centre of exchange, is favorable for trade. The principal articles of import are wood and iron. Steam-boats ply regularly between the Puerto and Cadiz. Pop. about 22,000.

Pufendorf, poo'fēn-dōrf, **Samuel**, BARON VON, German publicist and historian: b. Chemnitz, Saxony, 8 Jan. 1632; d. Berlin 26 Oct. 1694. He studied theology and law at Leipsic and in 1657, philosophy at Jena; was tutor in the house of the Swedish ambassador at Copenhagen, and by his work, 'Elementa Jurisprudentiæ Universalis' (1660) secured the appointment, the first in Germany, to the professorship of the law of nature and of nations at Heidelberg in 1661. Here he taught till 1670, and wrote 'De Statu Rei Publicæ Germanicæ,' published in 1667 under the pseudonym of Severinus Mozambano, and which, from the hardy way in which some of the imperfections of the Germanic constitution are exposed, raised a storm of controversy. Partly with a view to escape unpleasant consequences, Pufendorf accepted in 1670 the post of professor of natural law in the university at Lund, offered him by Charles XI. of Sweden. He there wrote his work on natural law, 'De Jure Naturæ et Gentium' (1672), which superseded the former; soon after appeared the abstract of this work, 'De Officio Hominis et Civis' (1673), which has passed through innumerable editions and been translated into several languages. Pufendorf in these works deviated still further than Grotius from the scholastic method of philosophizing, and consequently excited violent opposition. Some years afterward he was appointed secretary of state, royal counsellor, and historiographer at Stockholm. There he wrote in Latin the 'History of Sweden from the Campaign of Gustavus Adolphus in Germany to the Abdication of Queen Christina' (1676), and the 'History of Charles Gustavus' (1696), and in German his 'Einleitung zur Geschichte der vornehmsten

Reiche und Staaten' (1682). These works so much increased his reputation that in 1686 he was called to Berlin as counsellor, historiographer, and judge of the supreme court of judicature. In 1690 he was made privy-councillor of the Elector of Brandenburg, and in 1694 was created baron by Charles XI., king of Sweden. Pufendorf's legal writings are regarded as marking an epoch in the history of natural law, treating it as based upon the social instinct and developing it as a philosophical morality, while allowing scope to revelation.

Puff-adder, one of the names of the American serpents of the genus *Heterodon* (see HOGNOSE); also of the South African death-adder (q.v.).

Puff-balls. See FUNGI.

Puff-birds, a family (*Bucconidae*) of tropical American picarian birds, resembling kingfishers in form, but living on insects like flycatchers. They are closely related to the barbets.

Puffer. See GLOBE-FISH.

Puffin, a kind of guillemot or auk (q.v.) common on all far northern sea-coasts, where they breed on remote cliffs in large companies. They compose the genera *Fratercula*, *Lunda*, etc., and are distinguished by the large and greatly compressed beak, which is deeply furrowed by three grooves on each side of the mandible. The colors of the beak also add to its singular appearance; this structure being colored bluish-gray at its base, orange-red in the middle, and bright red at the tip. Lastly a large portion of it is annually molted. The body is short, stout, and rounded. These birds excavate burrows in sandy ground, each depositing a single egg of white color. They are able to bite and scratch severely by means of their bills. Puffins swim and dive with great ease; their food consisting of the smaller fishes, and chiefly the young of the sprats and herrings. They are caught and their flesh is salted for food by the inhabitants of the Orkney and Shetland Islands. The appearance of the bill in these birds has gained for them the British provincial names "coulter-neb" and "sea-parrot."

Pug. See DOG.

Pug Mill. See CLAY.

Pug'aree, or **Puggery**, a piece of muslin worn round a hat or helmet in hot climates or warm weather, the ends being left falling down, to protect the head by keeping off the rays of the sun.

Pugatscheff, poo'gä-chëf, **Yemelyan Ivanovitch**, Russian revolutionist: b. Simoweisk, on the Don, Russia, about 1726; d. Moscow, Russia, 10 Jan. 1775. He was leader of a band of robbers in his early youth, served in the Seven Years' war in the Russian, Prussian, and Austrian armies successively, and on his return to Russia was implicated in a seditious movement and imprisoned. He escaped and, prompted by his resemblance to the murdered Peter III., pretended to be the czar. The peasantry flocked to his standard, and were promised relief from their oppressions. His forces constantly increased and success for a time attended him. With 16,000 men in his army he captured Kazan, the old Russian capital, and moved upon Moscow, when he was betrayed by his followers to Suvaroff, captured, and taken

PUGET — PUGIN

in an iron cage to Moscow, where he was executed.

Puget, Pierre Paul, pē-ār pōl pū-zhā, French painter, sculptor and architect: b. Marseilles 31 Oct. 1622; d. there 1694. He began his career in art as apprentice to a ship-builder named Roman, who set him to carving the figure decorations for the prow and poop of galleys which the prevailing fashion demanded. At 17, however, he gave up this pursuit and traveled to Italy on foot, visiting Genoa, Florence and Rome, and in the latter place entered the school of Pietro da Cortona. This master's influence was always apparent in Puget's painting. In 1643 he returned to Marseilles and to ship-designing. Later he spent six years at Rome in company with a feillant monk on a commission from Anne of Austria to make drawings of antique monuments. After 1653 he painted pictures for churches of Marseilles, Aix and Toulon; but finally abandoned painting on the advice of physicians. His first work as a sculptor, the caryatides supporting the balcony of the Hotel de Ville, Toulon, was a venture into realism, the figures being studied from the porters on the quays. These received the praise of Bernini. He produced two works similarly conceived, 'Hercules Overcoming the Hydra' (now in the Musée de Rouen), and 'La Terre' for the Chateau de Vaudreuil, Normandy. His other works are more in the manner of the Italians of the 17th century, an influence confirmed by another visit at the instance of Fouquet. The fall of that minister put an end to his commission, and Puget settled in Genoa, where he sculptured a 'St. Sebastian and St. Ambrose' for the Church of Santa Maria-in-Carignano and a 'Conception' for the Brignoli, now in the Albergo dei Poveri. His natural restlessness induced his return to France, where he became attached to the arsenal of Toulon as decorator of war vessels. But under the patronage of Colbert he resumed sculpture and executed the 'Milo of Crotona,' 'Alexander and Diogenes' (bas relief), and later the 'Perseus and Andromeda,' all three at present in the Louvre. The 'Alexander and Diogenes' has been called "the triumph of picturesque sculpture," though, as Delacroix has pointed out, its subject is one impossible for sculptural treatment as the ray of sunlight which Alexander intercepts can not be represented. His architectural works are not numerous, though he erected the church of the Charité and the Capuchines at Marseilles. Consult: Lagrange, 'Pierre Puget, Peinteur, Sculpteur, Architecte' (1868); Emeric David, 'Histoire de la Sculpture française' (1872).

Puget (pū'jēt) Sound, in the State of Washington, is a large, irregular inlet from the Pacific Ocean. The Sound proper begins at the junction of Juan de Fuca and Georgia straits, and extends south, dividing into two main branches, the eastern one called Admiralty Inlet, and the western Hood Canal. Some of the largest Sound inlets on the east shore are Elliot, Poverty, and Commencement bays; on the west shore, Dogfish Bay and Dye's Inlet, and on the south shore, Carrs, Budd, and Totten inlets. The area of this great landlocked body of water is about 2,000 square miles. It has a number of islands, Vashon and Bainbridge being the largest. A number of rivers, having their headwaters in

the Cascade Mountains, flow into the Sound; the principal river inlets are Duwamish, Nisqually, Nooksak, Puyallup, Skagit, Skokomish, and Snohomish. The Sound has a number of large and safe harbors, and many miles of deep-water front. There is scarcely a sunken rock or reef in the whole body of water. The waters teem with fish; 95 varieties of food fish have been found. The shores are well-wooded, although there has been extensive lumbering in the surrounding forests. The fir is shipped to foreign ports for use in shipbuilding. The cleared lands in the vicinity make most productive farms. Seattle, Tacoma, and Port Townsend are the largest towns on the Sound; but all natural conditions exist for an extensive commerce.

Pughe, pū, William Owen, Welsh antiquary: b. Tyn y Bryn, Merionethshire, 1759; d. 1835. Going to London at 17 he there met the Welsh literary student Owen Jones, and the two published in 1795 the poems of Dafydd ap Gwilym, a 14th century bard. They subsequently edited other Welsh poems, and, assisted by Edward Williams, published the 'Myvyrian Archaeology of Wales' (1801-7). Pughe edited also 'The Welsh and English Dictionary' (1793-1803); the 'Cambrian Biography' (1803); etc. He accomplished not a little in arousing interest in Welsh language and literature.

Pu'gilism. See BOXING.

Pugin, pū'jīn, Augustus Charles, English architect and draughtsman: b. Normandy 1762; d. London 19 Dec. 1832. He settled about 1798 in London, where for many years he was assistant to the architect Nash. He subsequently devoted his attention to mediæval architecture, and published 'Specimens of Gothic Architecture selected from various Ancient Edifices in England' (1821-3). With John Britton he published 'Architectural Illustrations of the Buildings of London' (1824). Later works were 'Specimens of the Architectural Antiquities of Normandy' (1825-8) with Le Keux; 'Gothic Ornaments selected from various Buildings in England and France.'

Pugin, Augustus Welby Northmore, English architect: b. London 1 March 1812; d. Ramsgate, Kent, 14 Sept. 1852. He early displayed skill and facility in architectural drawing and acted as assistant to the Grieves in painting scenery for Covent Garden and Her Majesty's Theatre. His taste for Gothic art was turned to account in designing the furniture for Windsor Castle, and in supplying Messrs. Rundell and Bridge with designs for mediæval plate. He became a convert in 1834 to Roman Catholicism, and devoted himself thenceforth to the illustration and revival of Gothic architecture in connection with the Roman Catholic Church. His treatise 'Gothic Furniture and Iron Work' appeared in 1835, and attracted attention. In the following year he published 'Contrasts, or a Parallel between the Noble Edifices of the 14th and 15th centuries and Similar Buildings of the Present Day,' in which he expressed in no measured terms his views as to the decadence of ecclesiastical architecture. Other works of Pugin were 'The True Principles of Pointed or Christian Architecture' (1841); 'An Apology for the Revival of Christian Architecture' (1843); 'The Glossary of Ecclesiastical Orna-

PUISNE JUDGE — PULITZER

ment' (1844). He was employed by Sir Charles Barry in the decoration of the houses of Parliament, and was connected with Hardman of Birmingham in the manufacture of the renowned Gothic brass-work, besides having a share in the manufactory of stained glass in the same town. Latterly his intellect gave way, from the incessant excitement and labor to which it was subjected, and he was removed to an asylum.

Puisne (pū'ně) **Judge**, in law, a former term for a younger or inferior judge.

Puket, poo-kēt', or **Tonka**, a port of Lower Siam, the chief town of Junkseylon or Salang island, on the west coast of the Malay Peninsula. The town is on the east coast of the island at the entrance to a wide and deep bay. It is the seat of the commissioner of the west coast. Its importance is due to its valuable tin mines yielding an annual average of 3,000 tons. Pop. est. 20,000.

Pulangui, poo-lān'gě, river of the Philippines, the upper part of the Grande de Mindanao. See MINDANAO, GRANDE DE.

Pulaski, pū-lās'kī, **Casimir**, **COUNT**, Polish soldier of the American Revolution: b. Lithuania 4 March 1748; d. Savannah, Ga., 11 Oct. 1779. He studied law, served in the army under Charles, duke of Courland, and in 1769 engaged with his father and brothers in the uprising against King Stanislas Augustus. He commanded the insurgents for a time after the death of his father and brothers and in 1771 made an unsuccessful attempt to capture the king at Warsaw which resulted in a sentence of outlawry being passed upon him. Further resistance was soon rendered useless by the coalition of Russia, Austria, and Prussia, and Pulaski made his escape to France where he met Franklin and offered his services to the cause of American independence. He obtained letters from Franklin to Washington and in 1777 joined the army of the latter as a volunteer. He performed distinguished service at the battle of Brandywine and received from Congress promotion to the rank of brigadier-general in command of a division of cavalry. He resigned his command after five months, joined the main army at Valley Forge and received permission from Congress to organize an independent corps of cavalry and light infantry which became known as Pulaski's Legion. In 1779 he marched with his men to join General Lincoln in South Carolina where he performed effectual service. In the siege of Savannah he commanded the French and American cavalry and in an assault on 9 October was mortally wounded and was carried on board the United States brig Wasp in Savannah harbor where he died two days later.

Pulaski, Fort. See FORT PULASKI.

Pulcheria, pūl-kě'rī-a, Byzantine empress: b. 399; d. 453. She was the daughter of the Emperor Arcadius, upon whose death in 414 she became co-ruler with her brother Theodosius II., who was content to leave the reins of power in her hands. With her two younger sisters she took the vow of virginity, as she was determined that there should be no contests between three husbands for the empire. She condemned the Nestorian and Eutychian heresies and was on the friendliest terms with Cyril of Alexandria, Pope Leo the Great, and other great

men of the time. She was a fine scholar, earnest in her devotion to the Church and active in promoting the welfare of her subjects. She arranged the marriage of her brother and after the marriage of his daughter with Valentinian III., she retired for a time from the court. On the death of Theodosius, however, in 450 she again assumed the throne, for state reasons was absolved from her vow of virginity and married the general Marcian whom she raised to the throne as her colleague. After her death she was canonized and her feast is still celebrated in the Greek Church.

Pulci, Luigi, loo'jě pool'chě, Italian poet: b. Florence 15 Aug. 1432; d. Oct. 1487. He came of a family in which poetical talents were hereditary; and had two brothers who were also poets, Bernardo, who wrote elegies on Cosmo de' Medici and translated Virgil's Eclogues, and Luca, who composed stanzas on the Tournament of Lorenzo de' Medici. Luigi far surpassed his elder brothers in talent, and became an intimate of the household of Lorenzo the Magnificent. At the instance of Lucrezia Tornabuoni, mother of Lorenzo, he composed an epic poem, 'Il Morgante Maggiore,' based on the tale of Roland, and recited it canto by canto at the table where such men as Poliziano, Ficino, Michelangelo Buonarroti, and Cristófero Landino gathered. This fact accounts for the diversity of its contents both in respect to the subject matter and the spirit in which it is handled. He assumed the tone of Florentine society at the time of its composition, and inserted at will or to suit the changeable temper of his audiences passages of moving pathos or sincere devotion amid others of coarse buffoonery and broad humor. He fell in with the general Italian tendency of treating the Carlovingian legend with less seriousness than did Northern peoples, but he infused a specially bourgeois spirit by his use of many words of the Tuscan dialect. It has been asserted that Shakespeare's familiarity with Pulci is evidenced in his creation of Iago and Othello. Byron was a confessed admirer, and translated the first canto of 'Morgante Maggiore' which he published with 'Beppo' and the 'Vision of Judgment.' See PUNCHINELLO.

Pulcinello, pūl-chī-ně'l'ō. See PUNCHINELLO.

Pulilan, poo-lě'lān, Philippines, pueblo, province of Bulacán, Luzon; on the Quiñgua, five miles above its junction with the Grande de Pampanga; eight miles northwest of Bulacán, the former provincial capital. Pop. 10,100.

Pulitzer, pū'līt-sér, **Joseph**, American journalist: b. Budapest, Hungary, 10 April 1847. He came to the United States in 1864 and joined a Federal cavalry regiment, serving till the end of the Civil War; then became a reporter on the 'Westliche Post,' which Carl Schurz had made the leading German newspaper in Saint Louis. Beginning upon the lowest round of a journalist's career, and at first enduring considerable hardship, he rapidly won recognition and rose to the position of managing editor and chief proprietor of the paper. In the meantime he had acquired a knowledge of law, had been admitted to practice and been active in politics in the Republican ranks. He was elected to the Missouri legislature in 1869, was a delegate to the convention of the Liberal Republican party at Cincinnati, which nominated Horace Greeley for president, then

became a Democrat and in 1874 was a member of the Missouri State constitutional convention. In 1876-7 he was Washington correspondent for the *New York Sun*, and in 1878 bought the *Saint Louis Dispatch* and united it with the *Evening Post* as the *Post-Dispatch*. In 1883 he purchased the *New York World*, soon building up a large circulation, and with this journal his name has since been mainly identified. He was elected to Congress in New York in 1885-7 but resigned after a few months. In August, 1903, announcement was made of the endowment of a College of Journalism by him at Columbia University. He has also endowed several scholarships at Columbia College and given largely to other educational and charitable causes.

Pulkova, Russia, village, in the government of Saint Petersburg; about 10 miles southwest of Saint Petersburg. Its fame consists in being the site of the most important observatory in Russia. The place is the home of students.

Pulkova (pool'kō-vā) **Observatory**, in Russia, founded by the Czar Nicholas, and built in 1835-9, is at the village of Pulkova; lat. 59° 46' 18" N., and lon. 30° 19' 40" E. It was intended for the study of sidereal astronomy. The chief instrument, the refractor, with a 15 inch aperture, was not equaled by any other like instrument in the world, until 1870 when the Newhall Observatory (q.v.), in Newcastle, England, secured a 24 inch refractor. Next came the 26-inch refractor for the Naval Observatory (q.v.) in Washington, D. C. In 1885 the Pulkova Observatory erected a 30 inch refractor made by Clark & Sons of Cambridgeport, Mass. This instrument is (1904) excelled by the 36-inch Lick glass, and the Yerkes telescope at the University of Chicago. The determinations of fundamental star places, as made at the Russian Observatory, are regarded as most accurate, and its investigations cover a wide field. The Observatory is not only doing remarkable original research; but it is also a training school for astronomers and geodesists. Doctor Otto Struve has been the director from the beginning. The Repsold of Hamburg mounted the Russian telescope.

Consult: 'Description de l'Observatoire Astronomique central de Poulkova'; 'Zum 50-jährigen Bestehen der Nicolai-Hauptsternwarte'; 'Publications de l'Observatoire central Nicolas.'

Pul'lan, Richard Popplewell, English architect and archæologist: b. Knaresborough, Yorkshire, 27 March 1825; d. Brighton, Sussex, 30 April 1888. He was educated at Christ's Hospital, studied church architecture and in 1851 was engaged with Wyatt in charge of the decoration of the Byzantine and Gothic halls in the Crystal Palace. In 1854 he visited Sebastopol where he made a model of the country and fortifications, which he exhibited on his return home. He was commissioned in 1857 by the architectural department of the foreign office to examine the Halicarnassus mausoleum and also to make excavations at Cnidus; in 1862 he was engaged in excavating the temple of Bacchus at Teos and that of Apollo Smintheus in the Troad; and in 1869 was engaged in a similar task at the temple of Athene Polias at Priene. He wrote: 'History of the Discoveries at Halicarnassus' (1862-3); 'Byzantine Architecture' (1864);

'Lectures on Christian Architecture' (1879); 'Principal Ruins of Asia Minor' (1865); 'Eastern Cities and Italian Towers' (1879); etc.

Pullè, Giulio, joo-lē'ō poo-lā, COUNT ("RICCARDO CASTELVECCHIO"), Italian dramatist: b. Verona, Italy, 1820. He attained much popularity as a dramatist and among the most successful of his numerous works are 'Romilda'; 'Il Duca ed il Forzato' (1856); 'La Donna romantica' (1858); 'L'Ecole des Femmes'; 'La Donna pallida' (1888); etc.

Pullè, Leopoldo, COUNT ("LEO DI CASTELNUOVO"), Italian dramatist, son of Giulio Pullè (q.v.): b. Verona, Italy, 17 April 1847. He is prominent politically, has held various important municipal offices, is connected with the leading dramatic societies, and as a dramatist has won considerable attention. His publications include: 'Il guanto della Regina'; 'Bere o affogare'; 'Pesce d'aprile'; 'Scene e fiabe' (1889); 'Discorsi parlamentari di Marco Minghetti' (1890); etc.

Pul'en, Henry William, English Anglican clergyman and author: b. 29 Feb. 1836; d. 26 Dec. 1903. He was educated at Marlborough and Cambridge, took orders in the English Church, became a minor canon of York in 1862, and was minor canon of Salisbury 1863-75. He became chaplain of the Alert during its Arctic expedition of 1875-6, and for his services on that voyage was awarded the Arctic medal. He attained a sudden fame by the publication in 1870 of the brilliant 'Fight at Dame Europa's School,' of which 193,000 copies were sold and 14 translations made. He also wrote: 'Modern Christianity a Civilized Heathenism' (1872), the circulation of which reached 20,000 copies; 'The Ground Ash, a Public School Story' (1873); 'The Council of Canterbury' (1882); 'The House That Baby Built' (1874); 'Pueris Reventia' (1893); 'Venus and Cupid' (1896); 'Fred and Fritz' (1898). He edited Murray's 'Handbooks to Italy, Rome, and Greece' (1886-96).

Pulley, a mechanical appliance by which a force applied at one point is transmitted to and acts at another with a change in its direction or intensity, or in both. By its application the power exerted may raise a weight much larger than itself, or impart to the weight a velocity much greater than its own; but, as in the case of all mechanical devices, the energy is merely transformed; never created.

In its simplest form it consists of a wheel of wood or metal which turns on a smooth axle attached to a surrounding frame, usually in the form of a block. The rim of the wheel is grooved so as to allow a rope, cord, or chain to pass around it. Its principle of action is that of reduplication, depending on the fact, first enunciated by Stevin, about 1610, that the tension of a rope is the same at every point.

Under this principle a fixed peg would serve the purposes defined just as well as a wheel, which is introduced for the specific purpose of reducing the amount of friction.

In the single "fixed" pulley, Fig. 1, to satisfy the condition of equilibrium, the tension of the rope must be the same on both sides of the wheel, therefore, the power applied is equal to

PULLEY

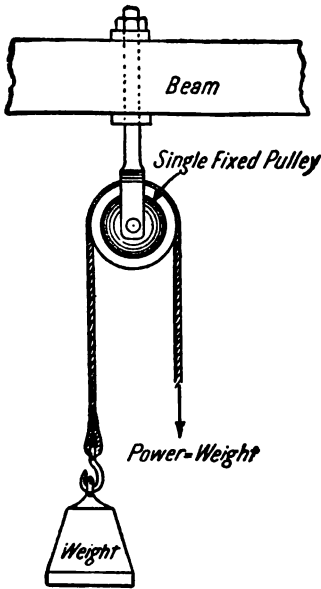


FIG. 1.

the weight, and although no mechanical advantage is gained by its use, it serves to change the direction of the force applied, and to obtain a pull on the beam to which it is attached, equal to twice the amount of that force.

In the single movable or "free" pulley with parallel strings, Fig. 2, as in the fixed pulley, the tension of the rope on both sides of the wheel is the same; but, since the weight is supported by two upward forces each of which is equal to the force applied, the power is equal

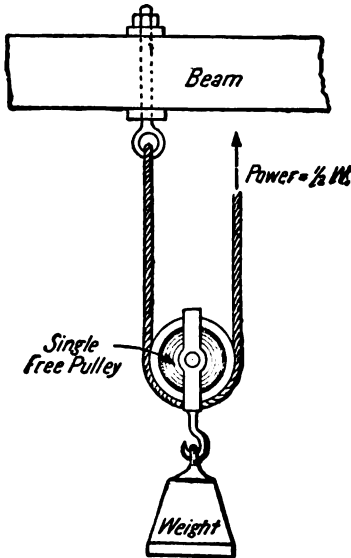


FIG. 2.

to one half the weight, or in other words, the power that will lift a given weight by the use of a single fixed pulley will lift twice that weight by the employment of a free pulley.

Fixed and free pulleys may be combined in various ways to obtain a mechanical advantage. In the combination shown in Fig. 3, the tension on the beam at (a) is equal to the power applied, and at (b) it is equal to twice that power; but the relation of the power to the weight re-

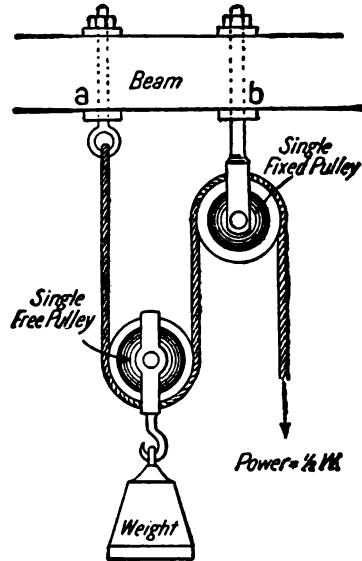


FIG. 3.

mains the same as in the case of the single free pulley.

If, however, the supporting strings pull at an angle (2ϕ), Fig. 4, the pulley is acted upon by three forces—the weight (w) acting vertically downward, and two equal forces

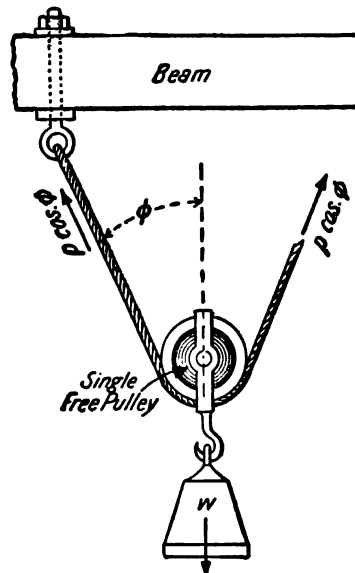


FIG. 4.

($p \cos. \phi$) acting upward. The resulting effect, $2p \cos. \phi = w$, shows a mechanical disadvantage,

PULLMAN

since the power required increases with the angle, and $p = \frac{1}{2}w$, as shown by Figs. 2 and 3, only when $\phi = 0^\circ$, that is, when the strings are parallel. When $\phi = 60^\circ$, the power is equal to

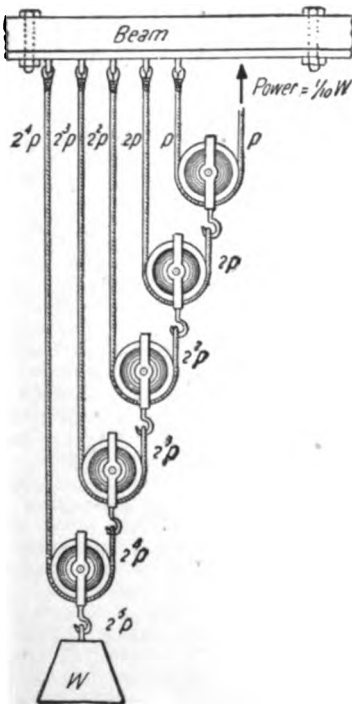


FIG. 5.

the weight; and when $\phi = 90^\circ$, or $2\phi = 180^\circ$, an infinite amount of power would be required to draw the rope out horizontal.

Combinations of pulleys or compound pulleys are usually arranged according to one of the

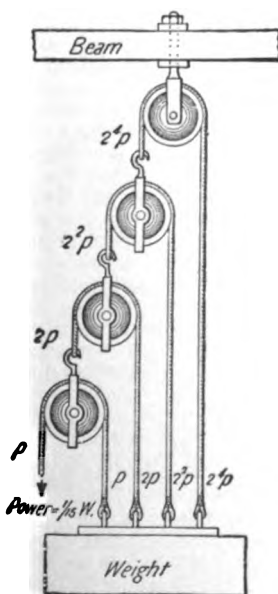


FIG. 6.

three systems represented by Figs. 5, 6, and 7, which indicate the action of the supporting forces.

In the first system, Fig. 5, five independent pulleys are supported by an equal number of branches from the main chord. The mechanical advantage stated in terms of weight (w) and power (p) is $w = 2^5 p$, or in general $w = 2^n p$, when (n) represents the number of pulleys.

In the second system, Fig. 6, the weight is supported by the four forces, $p + 2p + 2^2 p + 2^3 p = 15p = (2^4 - 1)p$, or in general, $w = (2^n - 1)p$.

In the third system, Fig. 7, one continuous string is divided into six branches by six pulleys, and since the tension of each branch is equal to (p) the power applied, $w = 6p$, repre-

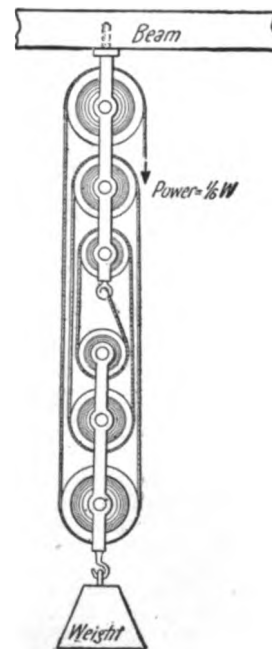


FIG. 7.

sents the mechanical advantage, or $w = np$, when (n) is the number of strings rising from the movable pulley. This is the form most frequently used practically, its most extensive application being the block and tackle devices of the running rigging of ships. See BLOCK; TACKLE.

For other examples of the application of pulleys, see TRANSMISSION OF POWER—Mechanical.

WILLIAM MOREY, JR.,
Consulting Civil and Mechanical Engineer, New
York City.

Pull'man, George Mortimer, American inventor: b. Chautauqua County, N. Y., 3 March 1831; d. Chicago, Ill., 19 Oct. 1897. He learned the cabinetmaker's trade, and during the construction of the Erie Canal he successfully filled contracts for removing various large buildings

PULLMAN—PULSE

in its proposed route. He then settled in Chicago and engaged in building, but devoted much time to the problem of making long railway journeys less tedious, the result being the conversion of two ordinary railway coaches into sleeping cars. They were a success and created a demand for more, and in 1863 he built the "Pioneer" at a cost of \$18,000, which was the first of the cars which have since borne his name. He organized in 1867 the Pullman Palace Car Company, of which he was president, and in 1887 originated the vestibule train. He amassed an immense fortune, founded a model town near Chicago, which he named Pullman (q.v.), and was interested in various other large commercial enterprises.

Pullman, James Minton, American Universalist clergyman, brother of G. M. Pullman (q.v.): b. Portland, N. Y., 21 Aug. 1836; d. Lynn, Mass., 22 Nov. 1903. He was graduated from Saint Lawrence University, Canton, N. Y., in 1860, ordained to the ministry in 1862, held pastorates in Troy, N. Y. (1860-7), New York (1867-85), and Lynn, Mass. (1885-1903). He organized the Young Men's Universalist Association of the City of New York in 1869, of which he was the first president. He was also president of the New York State Universalist Association, and founded the charity known as the "Children's Country Week" in 1882.

Pullman, Ill., a former town, now part of the city of Chicago; on Lake Calumet, 12 miles south of the centre of Chicago. It was founded in 1880 by George M. Pullman, and intended especially for the benefit of the employees of his company. Besides the Pullman Palace Car Company, which is located here, there are car wheel works, a foundry, and other industrial establishments. The town is well built, with wide streets, and several parks; it has a large general retail store, a theatre, a school, and a library. It was formerly under the government of the Pullman Company, but much dissatisfaction arose on account of high charges for water and gas, and in 1889 the town voted for incorporation with the city of Chicago. The company, however, was still the owner of the town and the store; and the exorbitant rents for the poorer tenements and dissatisfaction of the employees with the management of the town were among the causes of the Pullman strike in 1894.

Pulmona'ta, an order of non-marine gastropod mollusks, characterized by breathing atmospheric air; the snails. They are usually small, asymmetrical, and provided with a shell. The sexes are always united in the same individual, and the operculum is always wanting, except in *Amphibola*. The respiratory apparatus, which seems to have been modified from that of ancestors who breathed oxygen mixed with water, by means of branchiæ, is not lung-like in structure; it is simply a pouch lined with blood-vessels, and is properly called a pulmonary sac. The terrestrial species will endure deprivation of air for long periods; and the aquatic forms are able to live under water for many hours or days without apparent harm. The pulmonates are divisible into two groups,—one in which the eyes are on the tip of the upper tentacles (as in all the land snails), and another in which the eyes are at the base of the non-retractile tentacles (as in the pond-snails).

Pulo Malagi, poo-lō' mā-lā'hē, an island of the Philippines. See MALAGI.

Pulp. See PAPER.

Pulpit, a piece of furniture, sometimes movable, but as a rule stationary, from which sermons are delivered in a church. The word is derived from the Latin, "pulpitum," a platform or rostrum. Pulpits did not come into use until the 11th or 12th century. Previously to that time sermons were delivered from the rood-loft between the choir and nave, or some other elevated part of the church interior. Pulpits were often splendidly carved, making them valuable examples of art. Among the finest are those of Saint Germain l'Auxerrois in Paris, and Sainte Gudule in Brussels.

Pulque, púl'kē. This Mexican national beverage is produced from several species of agaves known as majuays (*A. salmiana*, *potatorum*, *Americana*, etc.), which are extensively cultivated on the plains of Apam, in a radius of 50 to 100 miles from the Mexican capital. So extensive is the industry that the plantations of Hidalgo, Tlaxcala, and Puebla, are valued at nearly \$15,000,000, and the railways have transported over 80,000 tons in a single year. On the Mexican railway running to Vera Cruz a special train carries daily \$1,000 worth of pulque to Mexico City, the liquor being transported in goat skins and barrels. When one of these huge plants reaches maturity its tendency is to throw up an immense flower stalk or mast, sometimes 25 feet high, with branches at the top, upon which the blossoms are formed. When a blossom bud appears the plant is ready to yield its juices, which after being collected is the pulque. The plant is "castrated" by making a long incision in the heart or central thickened portion, and the tender leaves of the unopened leaf cluster cut away, the opening being scraped out to form a cavity, into which the juices of the thick, fleshy, expanded leaves, slowly filter. This sweetish, slightly acid liquor is known as aguamiel (honey water) and in its fresh state slightly suggests the odor of root beer. It is removed morning and evening, and can be collected for a month, four quarts a day being the average yield. The collecting is done with a long narrow-necked gourd, with a small hole at either end. The operator places one end in the cavity of the plant, and the other to his lips; withdrawing the air by inhalation, the gourd is filled, and with finger on the hole it is carried to the nearby waiting mule laden with goat skins, and the liquor saved. At the depots the pulque is transferred to reservoirs often made of ox hide, and a little sour pulque added to induce fermentation, when it becomes cloudy. It is universally used by Mexicans, even being sold in the streets in bottles, like milk in this country. There are a thousand places in Mexico City where pulque may be purchased and drunk. The earliest use of the liquor is said to date back to the latter half of the 11th century and to the reign of the eighth Toltec chief, Tepzucolzin.

CHAS. RICHARDS DODGE.

Pulse (from Latin, *pulsus*, a beating), the rhythmical motion of an artery, with alternate expansion and contraction, in practice considered as a beating. This motion is strongest in the heart (q.v.), which is the centre of the arterial

PULSE GLASS—PULTOWA

system, and from that organ it is propagated through all the minutest branches of the arteries. In those which lie immediately under the skin it can be felt with the finger, as is the case with the radial artery, the pulsation of which is very perceptible at the wrist. The state of the pulse is therefore an indication of the action of the heart and the whole arterial system, and of the condition of the blood and the physical functions in general. The circumstances to be attended to in the pulse are either the number of pulsations which take place in a given time, and the regularity or irregularity of their occurrence, or the character of each pulsation. In the former case the pulse is said to be quick or slow according to the number of pulsations in a given interval; regular or irregular, as they occur at equal or unequal intervals. In the latter case it is strong or weak, hard or soft, full or small, etc. It is affected by the age, sex, and temperament of the individual, and by accidental circumstances, as sleep, food, exercise, heat, etc.

The pulse is most rapid in infancy, making from 110 to 140 beats per minute. During early childhood it makes from 100 to 110, and is regular, and rather soft and small. In youth it is much slower, making from 80 to 90 beats per minute. At this period it is regular, strong, rather soft than hard, moderately full. In mature age the number of beats is on the average about 75 per minute, and the pulse is regular, strong, or moderate, fluctuating between hard and soft, between full and small. In old age the number of beats sinks to about 60. In the female the pulse is more rapid, softer, and smaller than in the male. In persons of a sanguine temperament it is quicker and fuller than in phlegmatic individuals. Sudden agitation and violent passions make the pulse rapid and irregular; joy makes it quick and strong; long-continued grief, languid and soft. The pulse is, therefore, a highly important indication of the state of the system. A deviation from the regular pulse of an individual indicates a disordered state. When the irritability of the system is so heightened as to produce fever or inflammation the pulse is accelerated. If the action of the nervous system is irregular, or unduly heightened, the pulse becomes frequent and irregular. In case of mechanical obstructions to the circulation, as in dropsy of the pericardium, polypus in the heart or in the great arteries, the pulse is irregular and interrupted.

The study of the pulse began with the ancients. Galen wrote several works on it, and for several centuries the subject of pulsation remained much as he left it. The demonstrations of the circulation of the blood by Harvey, and of the irritability of the muscular fibre by Haller threw new light on it, and medical science at last has brought it under full investigation, and has explained it in all its physiological aspects.

Pulse Glass, an instrument invented by Franklin to exhibit the ebullition of liquids at low temperatures. The bulbs are connected by a slender stem and partially charged with water, the supernatant air having been expelled by boiling, and the opening hermetically sealed by a blow-pipe. By grasping one of the bulbs the heat of the hand will cause the formation of vapor and drive the liquid into the other bulb, producing a violent ebullition in the latter.

Pulsometer. See PUMPS AND PUMPING MACHINERY.

Pulszky, pùl'skê, **Franz Aurelius**, Hungarian archæologist and publicist: b. Eperies 1814; d. Budapest 1897. When only 22 he was nominated to membership in the Archæological Institute of Rome. Joining the Liberal party under Kossuth he was elected a deputy to the Hungarian Diet in 1840 and later under-secretary to the Hungarian Prince Esterhazy, minister of foreign affairs in Vienna. He followed Kossuth to England and after the catastrophe of Villagos accompanied the ex-dictator to America. His impressions of this country were embodied in a book entitled 'White, Red, and Black.' Condemned to death by his country for treason, he lived in Italy and joined cause with the Garibaldians. The sentence was removed in 1866; in 1872 he became inspector-general of museums and public libraries. He wrote 'Philosophy of Hungarian History' (1882); 'My Life and Times'; and 'The Jacobins in Hungary' (1887).

Pulteney, pùlt'nî, **William**, EARL OF BATH, English politician: b. London 22 March 1684; d. there 7 July 1764. He was educated at Oxford, and in 1705 entered parliament. He was a partisan of Walpole, and after the accession of George I. was made privy councillor and secretary of war, 1714-17. In 1725 he became a political opponent of Walpole, gained great popularity by his crusade against his former friend, and when Walpole was forced from the ministry in 1742 Pulteney organized under the Earl of Wilmington a new ministry. The public was disappointed in the cabinet, and his acceptance of a peerage further destroyed his popularity. As member of the House of Lords he was not prominent, and when appointed premier in 1746 he held office but two days, being unable to form a cabinet.

Pultowa, pool'tô-vâ, or **Poltava**, Russia, (1) capital of the government of Poltava; on the Vorskla River; about 450 miles southwest of Moscow. It is walled and defended by a citadel on a small eminence. It is the commercial centre of a large farm and stock-raising region. The annual fairs, three in number, are of less importance than in former years. Here in 1709 Peter the Great defeated the Swedes under Charles XII. A monument in the principal square commemorates the event; and three miles from the town is the tomb of those who fell in this battle; it is still called the Swedish Tomb. Pop. about 55,000. (2) A government in the southwestern part of Russia in Europe, bounded on the north by Tchernigor, on the east by Kharkov, on the south by Ekaterinoslav, and on the west by Kiev; area, 19,265 square miles. The surface is a plain sloping from the northeast to the southwest, and drained chiefly by the Dnieper and its tributaries. It is one of the most fertile and best cultivated departments of Russia; it exports about one fourth of the whole produce of wheat, oats, and barley of the whole country. Tobacco is increasing in acreage. Stockraising and bee-keeping are given much attention. Manufacturing is limited; the chief products are leather, coarse woollen goods, brandy, and saltpeter. Oil is made from the seed of the sunflower and of flax. Pop. about 3,000,000.

PULTUSK—PUMPS AND PUMPING MACHINERY

Pultusk, pool'toosk, Russian Poland, town in the government of Lomza, on the Narev, about 32 miles north by east of Warsaw. It has several old buildings of historic interest, some manufactories, and considerable trade. It is noted as the scene of the defeat of the Saxons by Charles XII., in 1703, and of the Russians by the French in 1806. Population estimated, 16,000.

Pulvermacher Chain, in electricity, a form of galvanic battery consisting of a series of small wooden cylinders on which a zinc and copper wire are coiled side by side, but without touching each other. The zinc of one cylinder, touching the copper of the adjacent one, forms with it a couple. The whole is immersed in vinegar diluted with water. A chain of 120 couples forms a very powerful battery. See BATTERY.

Pu'ma, or Mountain Lion. See COUGAR.

Pum'ice, a variety of lava of a porous and fibrous structure, resembling that of a sponge in appearance, containing from 60 to 75 per cent of silica, with alumina, iron, lime, soda, etc. It varies in color from whitish-gray to yellowish-brown and will float in water. It is essentially lava from which steam or gas has escaped in large quantities while it was being consolidated. Its extreme roughness fits it for use in polishing. In the solid state it is used to polish paint, wood, metal, etc.; and, as a powder, for marble, ivory, bone, glass, and in the composition of tooth-powder. Pumice may be considered because of its glassy composition as a porous variety of obsidian (q.v.). Pumice is obtained in Mexico, Iceland, and Hungary, but chiefly from the Lipari Islands.

Pumpell'y, Raphael, American geologist: b. Owego, N. Y., 8 Sept. 1837. He was educated at the Owego Academy, and later studied sciences and mining engineering in Paris and at Freiberg, Saxony. He made geological investigations in Corsica, and after his return to the United States in 1860 visited Arizona, and in 1861-3 was engaged in scientific explorations under the government of Japan. In 1863-4 he made a private investigation tour through central, western, and northern China and Mongolia, and in 1864 engaged under the Chinese government in examining the northern coal fields. In 1866-73 he was professor of mining at Harvard, State geologist for Michigan in 1869-71, and in 1871-3 directed the State geological survey of Missouri. He was appointed to the United States geological survey in 1879-81, 1884-91, in charge of the Archæan division, and was organizer and director of the Northern Transcontinental Survey in 1881-4. The development of the iron ore industry in Michigan and western Ontario was largely due to his investigations in 1867-1901, and his time is now occupied in organizing and directing an exploration expedition to central Asia. He has published: 'Geological Researches in China, Mongolia, and Japan' (1866); 'Iron Ores and Coal Fields of Missouri' (1873); 'Geology of the Green Mountains' (1894); etc.

Pum'pernickel, the name given to a coarse brown bread made in Germany from unbolted rye. It is baked in large square loaves, which often weigh as much as 60 pounds. Its proper manufacture depends upon the treatment of the

dough, which must contain neither yeast nor leaven, and also on the management of the oven, in which the batch must remain from 12 to 14 hours.

Pump'kin, any of several annual vine-like herbs, especially *Cucurbita pepo*, of the order *Cucurbitaceæ*, probably of tropical America, but not known in a wild state. It is a coarse tendril-bearing vine frequently exceeding 20 feet in length, with prickly stems and leaf stalks; bears large rough leaves; large yellow flowers, the pistillate being followed by large variously colored but generally yellow fruits, with hard rinds, thick flesh and many seeds. The plant is widely cultivated in warm and temperate countries for its fruits, which range in weight from 10 to 40 pounds, but in some varieties weigh far more. They are largely used for stock feeding and for making pies. The cultivation is essentially the same as for squashes; but in America the plants are most frequently grown in corn fields, the seeds being sown at intervals of about 12 feet, and the plants allowed to shift for themselves after the corn is laid by. It is affected by the same insect-enemies as the squash (q.v.).

Pumps and Pumping Machinery. The term "pump," commonly used to designate the various forms of mechanical devices by which liquids and gases are moved, is of very doubtful origin. It might have been derived from the French "pompe," or the German "pumpe," "plumpfe," or the Latin "plumbum,"—lead, the last-named although advanced by some authorities, appears to be the result of a rather far-fetched conclusion. In its broadest application it designates a multifarious variety of appliances and machines, some simple and others of complicated mechanical construction, which may be grouped into four general classes—"bucket-lifts," "displacement-pumps," "impellers" and "impulse" pumps, according to their mode of action, and disregarding their motive power.

"Bucket-lifts," for raising water from wells or other sources to receiving points above that of the supply, by means of a counterbalanced pole or sweep (swape), and by a windlass or wheel, operated by hand, or with the aid of draught animals, represent the earliest forms of pumps. They were used during the remotest periods, and are commonly used even at the present time, their application not being confined so much to particular localities as to their cheapness and the limited supply of water required. The most primitive device of this character was probably the "cistern-pole." Pliny, 52 A.D., mentions it in his description of the various methods employed in watering gardens. He states: "Water is drawn from wells and tanks by plain poles, hooks and buckets." The "swape" was a natural evolution from the cistern-pole, and in the form of the "shadoof," of Egypt, is authentically recorded as having been in use over 1,500 years B.C., in the time of the Pharaohs, a period antedating the Exodus. It is still used extensively in that region, myriads of them lining the banks of the Nile, where they are worked unceasingly by relays of men, without intermission, day and night. It is also used extensively all over Hindustan, where it is called the "picotah." In fact, the "swape" in some form is used extensively in all of the Ori-

PUMPS AND PUMPING MACHINERY

ental countries from Asia Minor to China and Japan and also in Mexico and South America, for domestic purposes and for the irrigation of land. For the latter purpose, however, it was superseded in India by the "jantu," an oscillating wooden trough involving the same principle, that of the lever, and worked by hand. The "windlass and bucket" arrangements operated by cranks or by tread-wheels, the latter worked by men or animals, appear to have followed the "swape," first among the Chinese, and later among the earliest Greeks and Romans. Tread wheels appear to have been a common mode of applying human and animal effort among the ancients, and are often used even at the present time, although not so much in connection with pumping water. About the beginning of the Christian Era, Vitruvius, a Roman engineer, described a number of pumping machines involving a rotary principle—the "tympanum," "noria," "chain of buckets or pots," the "screw" and the "pump." The tympanum consisted of a series of gutters with their open ends joined to a shaft hollow at one end and placed above the surface of the water at the height to which the water was to be elevated. The gutters thus arranged radially extended to a short distance below the surface of the water which they scooped up successively when the shaft was rotated. Each gutter as it passed above the horizontal position, delivered its water to the shaft to be subsequently discharged through a trough at the desired point. This primitive device continued in use from the remote ages of antiquity up to the 18th century without any change of construction, when La Faye, a member of the Royal Academy of Sciences of France, improved it by substituting a series of curved canals for the original straight gutters, thus developing the progenitor of the "scoop wheel," which propelled by streams, are extensively used for draining purposes. La Faye's improvement and the geometrical reasoning which developed it are exhaustively described by Belidor (Tom. ii. 385, 387). While the tympanum consisted of a series of revolving gutters, the noria may be described as a number of "swapes" arranged around a central shaft like the spokes of a wheel, each swape carrying on its outer end a vessel which fills as the rotary motion of the shaft plunges it beneath the surface of the water, and subsequently discharges its liquid freight into a reservoir placed at the upper part of the circle. It is commonly known as the Persian wheel. The "chain of buckets or pots" was an elaboration of the simple bucket and cord arrangement, by the introduction of a pulley operating an endless rope or chain, to which several buckets or pots were attached. It was employed by all the foremost nations of antiquity, and is still used in many parts of Europe and Asia. Among half-civilized nations it was the highest type of hydraulic machines. Sometimes, when the source of supply was a river, as in the case of the Persian wheels on the Orontes, the driving wheels of the arrangement were placed in the river and propelled by its current. About the middle of the 17th century, European mechanics recognized that when the water was admitted into the receiving vessels of a noria or a chain of pots at the upper part of the circumference, it was converted into an over-shot wheel, thus affording a means of

power transmission to other machines, and in cases where the water supply was limited, but descended from a considerable elevation, it was substituted for the overshot wheel as a prime mover in operating mining pumps, dredging, threshing and other machines of a similar character; while as a conveyor, originally used exclusively as a water elevator, it has also been employed to raise mortar in the construction of buildings, city walls and fortifications, and for carrying grain and flour to the different floors of a mill. In its original form, that of the "sakia" of Egypt, it was unquestionably the pump introduced into Greece by Danaus when he dug the wells of Argos, 1485 B.C., about a thousand years before the building of Babylon by the Persians. Danaus was a brother of the Pharaoh Rameses, who reigned during the period the Israelites were in Egypt. He was compelled to leave that country on account of domestic troubles, and accompanied by his family and friends sailed for Greece. They landed on the coast of Meloponessus, and settled at Argos. According to Pliny (vii. 56), previous to the arrival of these Egyptians, the Greek were unacquainted with wells and pumps; therefore, it is natural to conclude that the wells of Argos dug by Danaus were equipped with the Egyptian pumping devices most adaptable to wells, which was the chain of pots, and not a form of atmospheric or force pump, the pioneer of which is described in Hero's 'Spiritalia' as invented by Ctesibius of Alexandria, one of the most eminent mathematicians and mechanicians of that period, in the year 224 B.C. The most modern refinement of the chain of pots is the "chain pump," while Vera's "rope pump" and the hydraulic belt are applications of the same idea, and consist of endless double bands of rope or woolen cloth passing over two rollers, one placed below the surface of the water, the other at the point of delivery. The rollers are driven at a velocity ranging from one to two thousand feet per minute, and as the bands pass over the upper roller, the water held between them by capillarity is forced out by the pressure and discharged into a receiving chamber connected with the delivery spout.

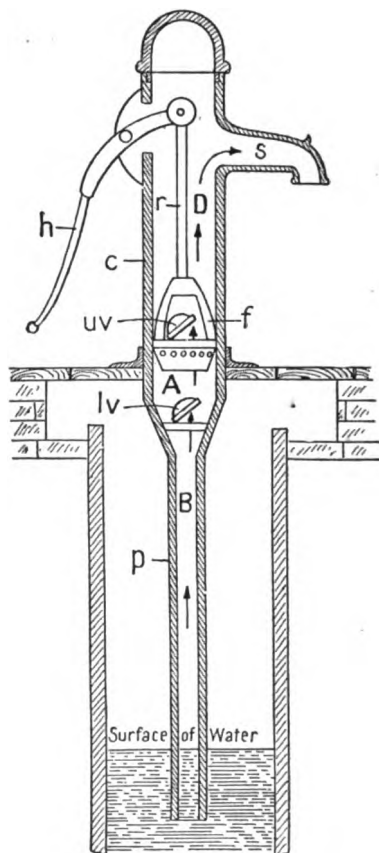
Machines embodying the principle of the screw, stated by some authorities as invented by Archimedes, the Greek geometrician and greatest mathematician of antiquity, and by others credited to the genius of Canon of Samos, a contemporary of Archimedes, about the year 242 B.C., are described by Vitruvius as of Egyptian origin, and were, according to other authentic records, employed in Egypt, for draining and irrigating land, many centuries before Archimedes visited that country. It consists of one or more flexible tubes of lead or leather, wound spirally around a solid cylinder of wood or iron, the ends of which are pivoted to supports, so that the whole arrangement may be revolved upon its axis, which is generally placed at an angle of 45° to the horizontal. The lower end of the tube is placed below the surface of the water, and the upper end over a receiving trough at the desired elevation. When the machine is rotated the water entering the lowest bend of the spiral is forced upward by each succeeding revolution into the other bends, and finally discharged out of the uppermost into the trough. The Roman screws were made with plank grooves arranged spirally around a solid

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cylinder, and the grooved cylinder thus constructed was fitted into and revolved within a hollow cylinder of the same length.

The connecting link between the various more or less elementary forms of water elevators or "lifts" already described, and the group of hydraulic machines designated as "displacement pumps," is the modern chain pump, consisting of a tube through which the water is raised by a series of pallets or pistons. The pump of Ctesibius appears to have been of this character, although it consisted of only two single-acting pistons working in a cylinder, the water being raised by the up-stroke and expelled by the down-stroke, into a common receiving chamber. In this machine the atmospheric pressure was not taken into consideration, and its capabilities as a water-lifter remained unrecognized until 1643, when Torricelli, the great Italian physicist, announced that water could be raised in a tube by the pressure of air. In 1641, Gallileo, when consulted by a Florentine pump-maker, had failed to demonstrate why water failed to rise in a closed tube above a height of 33 feet under the action of a suction pump. A year or two later, after the death of Gallileo, Torricelli undertook the explanation of that fact, his experiments finally resulting in establishing the law that the heights attained by liquids in a closed tube, the upper end of which was a vacuum, under the pressure of the atmosphere, was proportional to their specific gravities. For example, under these conditions, the height of a column of mercury would be about 28 inches, while that of a column of water would be about 33 feet at the level of the sea. The direct result of this experiment was the invention of the siphon barometer, in which the empty space above the column of mercury is known as the Torricellian vacuum; but, through the further experiments of Pascal, a French mathematician and divine, in 1646, followed by those of Otto Guericke, a philosopher and mathematician of Magdeburg, Prussia, and of Candido del Buono, a member of the Academie del Cimento of Florence, it led to the invention of the "air pump," an apparatus which is described under the title air pump, and which must not be confounded with the atmospheric or displacement pump used for pumping water, which was not unknown to the ancients, and was probably used in some of its innumerable forms, long before the days of Ctesibius. In its simplest form, the modern atmospheric or displacement pump consists of a cylinder (*c*) connected at the bottom with a pipe (*p*), the lower end of which is immersed below the surface of the water. In the cylinder are placed two valves (*uv* and *lv*), the lower stationary and the upper attached to a piston (*f*) at the end of a rod (*r*), which moves the piston up and down under the motion of a handle (*h*). A pipe or spout (*s*), attached to the cylinder near its upper end, receives and discharges the water raised by the working of the piston. Both the valves open upward, and the action of the entire arrangement, based upon the physical fact that two bodies cannot occupy the same space at the same time, is as follows: When the downward stroke of the handle moves the piston upward, the air in the space *A* being rarefied by having to occupy a greater space, and the partial vacuum thus formed relieves the pressure of the atmosphere

from the lower valve, which being opened upward by the pressure of the air in the space (*B*) of the pipe, allows a portion of it to pass into the space (*A*). When the piston descends under the upward stroke of the handle, the air in the space (*A*) is compressed, the lower valve



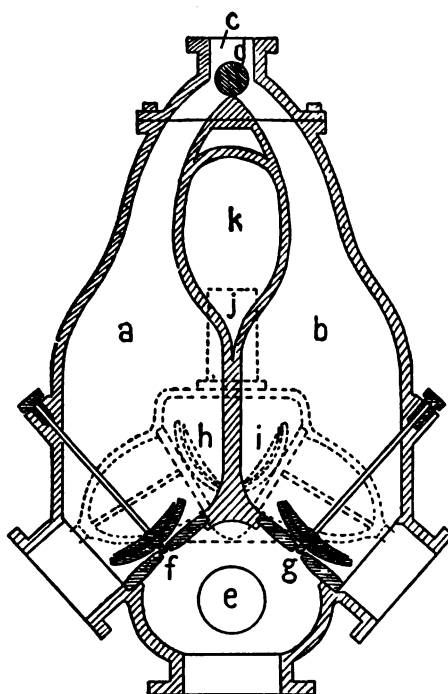
Modern Displacement Pump.

is closed, and when the density of the compressed air becomes greater than that of the atmosphere, the upper valve is forced open and the air passes into and out of the space (*D*). Thus, by the continued up and down movement of the piston, all the air in the space (*B*) is completely exhausted, allowing the water to rise in the suction pipe under the pressure of the atmosphere upon its surface in the well, until it fills the space (*B*) up to the lower valve. The next upward movement of the piston empties the air in the space (*A*), which is immediately filled with water by the opening of the lower valve. The downward motion of the piston closes the lower valve and forces the water through the upper valve into the space (*D*), from which it is discharged through the spout by the next upward movement of the piston which at the same time refills the space (*A*). Under the laws of fluid pressure established by the experiments of Torricelli and others, the height to which a column of water will rise depends upon the atmospheric pressure at any point on the earth's surface, and varies with the altitude of that point. At the level of the sea,

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the atmosphere exerts a pressure of about 15 pounds to the square inch, and will support a column of water in a closed tube from which the air has been exhausted, between 32 and 33 feet in height, while upon the top of Mont Blanc, or Pike's Peak, 15,000 or 16,000 feet above the sea, the atmospheric pressure will support a similar column of water about 16 or 17 feet in height. A knowledge of this fact is important not only in determining the maximum distance at which the lower valve of a pump may be placed from the surface of the water, but also in every branch of hydraulic engineering. There are numerous forms of displacement pumps. Usually they are equipped with a piston which fits the cylinder tightly and operates as already described. Some forms employ a plunger which but partly fills the cylinder, and instead of driving all the water out of it, merely displaces a volume equal to that of the plunger itself. In others, the displacement is effected by jets of air or steam. In all of them, valves form an essential part. In the simplest forms the valves are made of leather or rubber, and are fixed in position by a hinge on the edge. They are made in a great variety of forms and operate by pressure, or, as in the case of the Reidler valve, a German invention, by mechanical means. They usually consist of a "valve seat," to which the "disk" or valve proper is attached, the "stem" which controls the lift of the disk and prevents its displacement from the seat, the "cover plate," and the "valve spring," introduced in some forms to take up slacks. When a valve is required only to prevent the back pressure or a reverse flow, a single flap or check valve is used. In large pumps a number of small valves are employed, equal in the aggregate to a single large valve of sufficient size to allow the passage of the whole flow, thus preventing injurious shocks when the valves are opened and closed suddenly. Excepting the disks, all the other parts of a valve are made of bronze, while metallic ball and cone valves are extensively used in deep well pumps. The sub-classes into which displacement pumps may be grouped are almost innumerable, but the most important are the "reciprocating" pumps in which the pistons or plungers move alternately back and forth, or up and down, in a straight line, and are designated single-acting when the water is displaced by one part of the stroke, and double-acting when it is displaced by both parts of the stroke of the piston. In a single-acting pump, the water is forced into the ascending pipe only by the downward part of the stroke, and is discharged intermittently, while in the double-acting form, the discharge is continuous, thus saving the power wasted by the ever-recurring acceleration and retardation of the ascending column of water. Of the many methods employed to produce this very desirable result, the most common is that in which an air chamber is fixed vertically on the discharge pipe and receives the water forced upward by the downward stroke of the piston. The air in the chamber being compressed acts as a spring, and returns the force gradually to the ascending column of water as the piston moves upward, thus equalizing the pressure so as to give a uniform discharge. "Direct-acting" displacement pumps are so designated when the motive power is applied in a direct line with the movement

of the piston or plunger, and differentiates them from the "crank-and-fly-wheel," and the "beam pumps," when such devices are employed to transmit the motion. The additional designations—simple, duplex, triple, etc., are applied to pumps according to the number of pistons—one, two, three, or more, operated by a unit of motive power. "Rotary pumps" are equipped with revolving pistons, the axes of which are parallel, and the longitudinal surfaces formed into a series of curves which interlock on the inside and revolve with a tight sliding contact on the outside, against the curved walls of the pump chamber. Screw pumps and chain piston pumps are merely the modern refinement of very old ideas, while the "pulsometer," although one of the latest of modern pumping devices, may be regarded as the connecting link between ordinary pumps and what may be correctly termed "pumping-engines"—machines in which the pump and motive power are combined, the displacement being effected by steam. It consists



Pulsometer.

of two bottle-shaped chambers (a) and (b), the tapering necks of which incline toward each other in a common passage at (c). At the lower end of this passage is a valve (d), which when moved slightly will simultaneously close the opening of the neck of one chamber, and open that of the other.

Water is admitted into the chambers through the passage (e), and valves (f) (g) and forced out through the valves (h) (i), and passage (j) into the air chamber (k). The device operates as follows: Suppose both chambers are full of water and the valve (d) to the right. When steam is admitted to the chamber (a) the water is forced out by direct pressure through the valve (h) into the air chamber (k), so that when the chamber (a) is nearly or quite empty,

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the valve (*d*) moves to the left, cutting off the steam from the chamber (*a*) and admitting it to the chamber (*b*), from which the water is gradually forced out. In the meantime, the condensation of the steam in the chamber (*a*) creates a partial vacuum, and the pressure of the atmosphere on the external water forces it through the valve (*f*) into the chamber, so that when it is nearly full, the air it contains will be sufficiently compressed to force the valve (*d*) over to the right, thus producing a continuous action. The efficiency of pulsometers is equal to that of small direct-acting feed pumps, but they are extensively used on account of their simple construction and great durability.

The expansive energy of compressed air, hot air, and steam, was probably employed by the ancients, as the motive power of pressure engines to raise water, many centuries before the Christian era. There are extant numerous authentic descriptions of devices equipped with piston bellows, employed for this purpose by the ancient Egyptians, Hindus, Chinese, Peruvians and the Aztecs. Also descriptions of hot air devices, and pressure machines operated by steam, the majority of which were contrived by the members of the ancient priesthoods. A great many of these machines are described in the 'Spiritalia' written by Heron, or Hero of Alexandria, a celebrated Egyptian mathematician and physicist, who lived in the 1st century A.D. The water jet apparatus known as Hero's Fountain, although asserted to have been invented by him, was probably an old device at the time he described it. In either case, it is the oldest pressure engine ever described accurately in which a volume of air was used instead of a piston. In 1560, Baptista Porta, an Italian, published a work entitled 'Natural Magic,' in which he described a method of producing a vacuum by the condensation of steam, and its application to devices for raising water. Similar descriptions are given in the writings of Jerome Cardan, also an Italian, published sometime between 1515 and 1570. Therefore, although nothing new was discovered by Decaus, whose writings were published in Frankfort in 1615, and in Paris in 1624, or by Fludd, Worcester, Savery, and Papin, whose investigations and writings extended over the period from 1663 to 1698, the suggestions afforded by their experiments (subsequently elaborated by Freiburg in 1797, and Shone, Callon, Frizzel, and Pohle, in the period extending from 1870 to 1900), have led to the development of the various forms of modern air-lift pumps operated by compressed air, and pulsometers operated by steam.

Although pressure engines operated by air compressed under a head of water, as suggested by Papin in 1695, had been employed successfully to drain mines as early as 1755, when Hoel employed one in the mines of Chemnitz, Hungary, the application of steam for that purpose did not become an accomplished fact until a much later period. It is, however, interesting to note that the idea was suggested by Lord Bacon prior to 1679, in connection with the English mines, and was probably practically applied to a limited extent about that time. The history of the modern pumping engine, however, more properly begins with the construction of the Cornish engine. Up to the close of the 18th century, the only practical use of steam engines

was in connection with pumping devices, and many notable steam pumping engines had been erected and successfully operated in the mines of Cornwall, England. The various improvements made in this engine from 1800 to 1840 finally culminated in the evolution of one superior type which is now known as the "Cornish." This engine gave highly satisfactory service for the particular purpose for which it was designed—the raising of water out of deep mines where the constantly increasing depth of the shafts necessitated the adaptation of the same engine to the consequent increasing and changing loads. It is constructed upon the principle that the steam within the steam cylinder, is used to lift a weighted pump plunger which after being raised upward to the limit of its stroke, descends slowly by its own weight and forces upward a column of water equal to that weight. The economy produced by the expansion of the steam in the steam cylinder when the steam is cut off during the descent of the plunger is due to the fact, that the pressure and power of the steam first admitted is greatly in excess of what is necessary to lift the weighted plunger. This excess of power is taken up by the weights of the plunger at the beginning of its stroke, and given out at the end when the power of the exhausted steam in the cylinder has fallen below the amount necessary to move the plunger, unless assisted by the power previously stored in it. The length of the stroke of the piston and of the plunger being determined solely by the operation of its steam, equilibrium, and exhaust valves, it is absolutely necessary to maintain the steam pressure at a uniform rate, while the water raised must be received under a uniform head. In mine pumps, the steam cylinder is placed at the top of the shaft, and the pump at the bottom, near the surface of the water. The steam piston is connected to the pump plunger by a beam made of heavy timbers, the weight of which, together with that of the weight of the plunger, forms the weight which, after being lifted by the steam cylinder, raises an equal weight of water when the plunger descends.

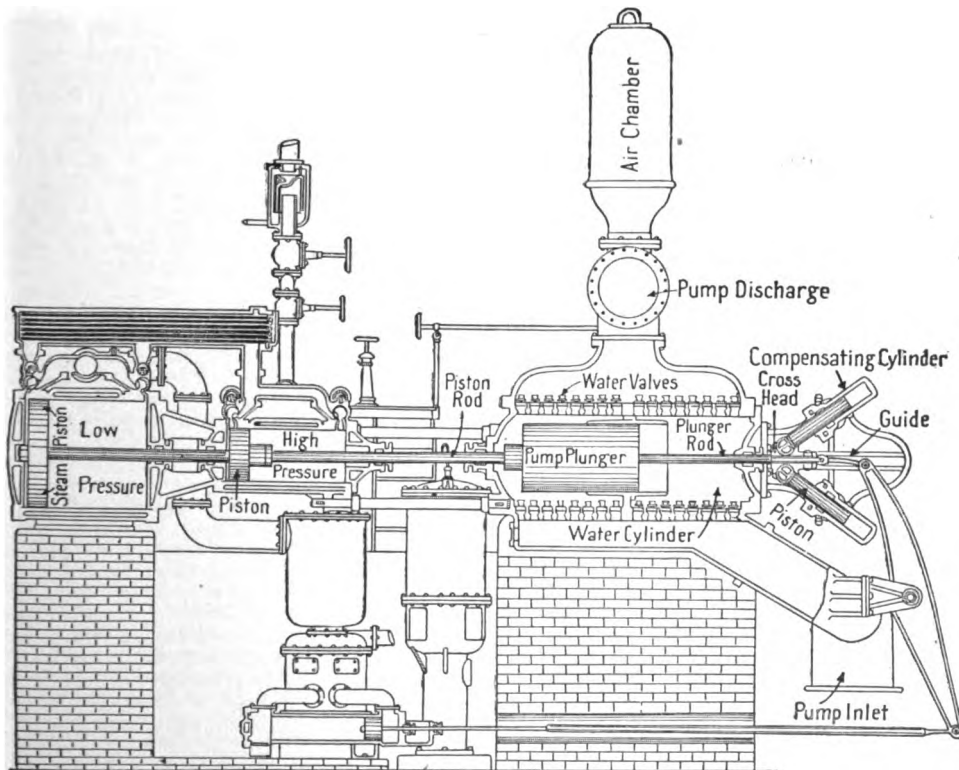
In order to preserve the proper relation between the weight of the pump rods and plunger, and that of the water columns, and also keep the engine and pump at the proper speed, by maintaining the proper difference in the weight of the pump rods so as to overcome the friction of their guides, and that of the water in the delivery pipes, a large box, called the "balance bob," in which the adjusting weights in the shape of stones or pieces of iron are placed, is attached to the upper end of the pump rods. When the shafts become deeper, and require the lengthening of the pump rods, the additional weight of the new timbers is counterbalanced by a readjustment of the weights in the "balance bob," thus adapting the engine to the new conditions. In its particular field of application, requiring only a slow action with no demand for uniform flow, it is safe to state that it has never been excelled by any other engine; but, its inordinate size, its action which requires the constant watchfulness of the engineer, its great first cost and expensive repairs, makes it unfit for waterworks, where the water has to be discharged through a long main to a great height above the pump, with a continuous and uniform delivery. The shortcomings of the Cornish en-

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engine, named above, led finally to its complete abandonment for waterworks, and called for a pumping engine that would fulfill the new requirements. This demand was met by the development of the "rotative" engine which, by employing revolving instead of reciprocating pistons, gave a positive motion. The steam power in the cylinder is applied to the pump piston in various ways—through the medium of long or short beams, bell cranks, or gearing, and in some instances, directly through the pistons themselves; in all cases, however, the limit of the stroke of the steam piston and of the pump plunger being governed by a crank on a revolving shaft. Attached to this shaft is a fly-wheel which is designed to assist the crank to pass the centre at each end of its stroke, and also to give up at the beginning of each stroke of the steam piston the excess of power imparted to it beyond that required to move the column of water. The function of the fly-wheel of a rotative engine is exactly similar to that of the weighted plunger in a Cornish engine; both of the devices being applied to their respective

use of steam at the expense of intricate machinery, but require expensive and massive foundations to absorb the shocks produced by their operation, while the momentum of the fly-wheel greatly increases the percentage of possible accidents. The Leavitt engines represent the vertical, and the Holly-Gaskill, the horizontal type.

To follow further the progress of pumping-engine construction up to the invention and development of the "direct-acting steam pumps," which now represent the highest type of pumping machinery, it is necessary to take up the historical thread in the United States. Although steam pumping engines of the direct-acting type, beginning with the device invented by Thomas Newcomen and John Cawley, of Dartmouth, England (which was subsequently improved by Watt, who developed it into an engine of the double-acting type), were in great use for many years; the greatest improvement in this class of pumping engines was made by Henry R. Worthington of New York, in 1840. His invention was the outcome of a long series



Worthington High Duty Pumping Engine.

classes of engines to obtain the best economy in the consumption of steam, the early cut-off resulting in a high grade of expansion, much higher than it was possible to obtain by any other means at the time. They vary greatly in design and in the details of construction, and are made in sizes ranging from those used for supplying water to small towns, up to some of the largest and most expensive machines in the world, and operate either vertically or horizontally. They produce great economy in the

of experiments on the application of steam to the propulsion of canal boats. It was a single direct-acting steam pump, and was employed to feed the boilers of his propelling engine, and was patented for the first time in 1841. A "direct-acting" steam pump is one in which the power of the steam in the steam cylinder is transferred to the piston or plunger in the pump by means of a continuous connection. It has no revolving parts such as cranks, shafts, and fly-wheels, like those of the rotative en-

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gines, nor the balanced beams and weighted plungers of the Cornish. Its action is due to the operation of a piston by a uniform pressure of steam through the entire piston stroke against a uniform water pressure in the pump, the pump piston-speed being governed by the difference between the power exerted in the steam cylinders over the resistance of the water in the pumps, while the length of the steam-piston stroke is limited and controlled by the admission, suppression and release of the steam used in the cylinders. Although steam pumps of this type came immediately into extensive use for feeding boilers, and for supplying moderate quantities of water under medium pressure, the intermittent action of their pump pistons, and consequent irregular flow of water prevented them from being used in waterworks and for other purposes where large quantities of water had to be forced through long lines of pipes. To overcome this serious defect, the same inventor produced the improved pump which is now generally known as the "Worthington direct-acting duplex steam pump." It consists of two direct-acting pumps placed side by side with the piston-rod of each pump connected by a lever to the slide valve of the opposite steam cylinder, so that the movement of each piston instead of operating its own slide valve, as in the single-acting pump, operates the slide valve of the opposite cylinder. The resulting valve motion is such that just before the piston of one pump has finished its stroke, the piston of the other begins its movement. The load of the water column is then taken up alternately and produces a steady flow without serious strains, harshness of motion, and noise, which characterize the action of the single-acting pumps, in which the water column is started into motion at the beginning, and arrested at the end of each stroke of the piston. Although the simplicity of their mechanism, together with the cheapness of their first cost and the certainty of their action, placed them at the head of all the machines of their class, when considered from a mechanical standpoint, the loss of economy in the use of steam continued to militate against their general use for large waterworks purposes. Their light weight prevented the cutting off of the steam in the steam cylinder so as to complete the stroke of the pump piston by the aid of the expansive energy of the steam thus cut off. Therefore the steam applied to move the pistons had to be applied in sufficient quantity and pressure to overcome the weight of the water column and its friction through the pump and connections, at the very beginning of the stroke, and maintained without diminution throughout the stroke, up to its termination, since a falling off in either volume or pressure during any part of the stroke would have stopped the action of the pump instantly. This defect, however, was completely eliminated by applying to them the principle of multiple expansion in the use of steam in compound condensing steam engines. Another steam cylinder was added to the end of the one already in use, and placed in a direct line with it so that the high pressure steam admitted to the first and smaller cylinder after moving its piston was exhausted behind the piston of the large cylinder upon its return stroke. Still further economy was produced in the larger compound engines by using a condenser to create a vacuum in the

large steam cylinder, thus bringing the efficiency fully up to that of the best high-duty rotative engines of the most important pumping plants of the world, their yearly records ranging from 50,000,000 to 120,000,000 duty.

The duty of the Worthington pumping engines was still further increased, and the entire arrangement, from the power-producing to the pumping ends, was made to represent the highest perfection of modern pumping machinery, by the application of the accumulator attachment, a device originally invented by J. D. Davis, in 1879, and perfected by C. C. Worthington, in 1884, and designed to cut off the steam in the steam cylinder at the beginning of the piston stroke, where it subsequently expands and acts as an auxiliary force at the end of the stroke, while at the same time the force exerted by the steam upon the pump plunger remains uniform through the entire stroke. In a compound direct-acting steam pump, it is attached to the plunger-rod which projects through the outer end of the pump chamber. On the end of this rod is fastened a cross-head which moves in guides attached to the outer end of the pump. On this cross-head, and situated opposite to each other, are two semicircular recesses. On the guide plates are two journal boxes, one above and the other below the plunger-rod, equidistant from it, and placed at a point equal to the half stroke of the cross-head. Each journal box carries a short cylinder hung on trunnions, which allow the cylinder to swing backward and forward in unison with the motion of the plunger rod. In these cylinders are plungers or rams, which pass through a stuffing box on the end. The outer ends of the rams have rounded projections which fit into the semicircular recesses on the cross-head, which, as it moves in or out, carries with it the plunger, thus tilting the cylinders backward and forward. These cylinders are called "compensating cylinders." When the engines are used for pumping water, they are filled with water, and when used for pumping oil, they are filled with oil. The pressure on their rams is produced by connecting the cylinders through their hollow trunnions with an accumulator, carrying a ram which moves up and down as the rams of the cylinder move in and out. This accumulator is of the differential type, the small lower cylinder of which is filled with water or oil, in which the ram moves, while the larger upper cylinder is filled with air. On the top of the accumulator-ram is a large piston-head which fits closely in the air cylinder. Therefore, the pressure per square inch on the accumulator-ram is equal to the pressure of the air in the air cylinder per square inch multiplied by the difference between the area of the air piston and that of the accumulator-ram. It is a matter of calculation and construction, which varies according to the particular service for which a pumping engine is designed; while the pressure in the air cylinder is controlled by the pressure in the main delivery pipe with which the air chamber is connected. The effect of this attachment on the successful operation of high duty pumping engines may be briefly described as follows: At the beginning of the outward stroke of the pump plunger-rod, the compensating cylinders point toward the outer end of the pump, with their rams at an acute angle with the plunger-rod, and push-

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ing against its advance under the full pressure of the accumulator load. As the plunger-rod advances outward, the angle between itself and the ram is increased. The rams recede into their cylinders, and their pressure against the rod is decreased until the pump plunger-rod has reached the halfway point of its stroke, when the rams will be at right angles to it—a position in which they neither retard nor advance its movement. As the pump plunger rod continues on its outward stroke, the angle between itself and the rams is again decreased, but now the rams pointing in the opposite direction, emerge from their cylinders, and exert their power to push the plunger outward to the termination of its outward stroke. It is obvious that similar conditions obtain during the return stroke of the plunger, the effect of the action being to store up power at the beginning of the stroke, either forwards or backwards, of the pump plunger, when the steam is under its greatest pressure, and to relieve it at the end of the stroke, when the pressure in the steam cylinder has fallen away to its lowest point, that is, below the amount necessary to move the plunger against the pressure of the water column.

The Worthington pumps are all of the horizontal type, and with this attachment and the use of multiple expansion steam engines, operate with absolute freedom from the noise and shock so characteristic of the crank and fly-wheel machines. Somewhat of an idea of the difference between the first duplex Worthington pumping engines and those of their latest construction may be obtained by comparing that of the Charlestown, Mass., waterworks, with its capacity of 5,000,000 gallons per day, with the installation at the Baltimore, Md., waterworks high service pumping station, which delivers 18,000,000 gallons per day. The former gave a duty of 70,000,000 foot-pounds, while the duty of the latter exceeded 140,000,000 foot-pounds per thousand pounds of dry steam.

The term "duty" represents the work done by a steam pumping engine expressed in millions of pounds of water lifted to the height of one foot by the consumption of 100 pounds of coal, 1,000 pounds of dry steam, or by 1,000,000 British thermal units (B. T. U.). On account of the variable quality of coal, the two last named constants give the more correct results, and are the values now employed in determining the comparative efficiencies of pumping engines, which range from 20.6 per cent for the high-duty engines, to about 0.13 per cent for jet pumps. During the last one hundred years, the development of pumping engines has increased their duty from about 5,000,000 foot-pounds for the Newcomen atmospheric engines, to over 170,000,000 foot-pounds for the crank and fly-wheel, or duplex triple expansion pumping engines of the latest construction.

The "centrifugal pump" is the best known representative of the "impeller" type. It embodies the principle—that a body revolving around a centre tends to move away from it with a force proportional to its velocity; thus the rim of a revolving wheel imparts a portion of its velocity to any substance adhering to it, and throws it off when the force of the velocity thus imparted exceeds the force of adhesion, as the mud thrown off by the wheels of a carriage, or the water from a mop or towel, rapidly revolved by the hand. The first pump of

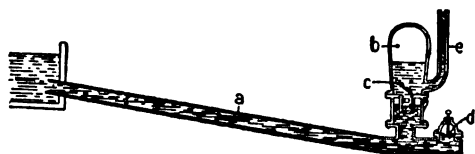
this type was invented by M. Le Demour, who sent a description of it to the Academie Francaise in 1732. It consisted of a straight tube attached in an inclined position to a vertical axis, around which it was whirled by a crank-handle. Later forms were constructed by tubes joined in the form of a T, the vertical tube of which was placed in the water. The lower end perforated to admit the water, and fitted with a valve to retain the water in the vertical tube when the pump was not in operation, was placed under the surface of the water and supported upon a pivot. The ends of the horizontal discharge tube were bent down into a circular trough over which they were revolved. When the machine was revolved rapidly the centrifugal force which discharged the water in the horizontal tube was communicated to the water in the vertical, which was also drawn out, but in the meantime refilled by the atmospheric pressure. When it is required to lift large quantities of water to a low elevation, centrifugal pumps may be used with greater efficiency than reciprocating pumps, the efficiency of which diminishes with the lift. A pump of this kind constructed in Massachusetts in 1818, was equipped with four blades set at right angles like those of a fan blower, and was used practically for many years. An improved form was exhibited by Appold in England, in 1851, which embodied all of the principal features employed in the best pumps constructed since that time. It is stated that Appold's pump raised continuously a quantity of water equal to 1,400 times its own capacity per minute. The "whirlpool chamber," designed to utilize the energy developed by the whirling water which in most pumps of this type is lost as eddies in the discharge pipe, was suggested by Thomson (Eng.), and consisted of a chamber somewhat larger than the pump, in which the water discharged by the pump disk, with considerable velocity, was allowed to rotate and impart its energy as an auxiliary aid to the driving power. A pump constructed by him for drainage purposes, in the Barbados, was equipped with a whirlpool chamber 32 feet in diameter, around a pump disk 16 feet in diameter. Others of large size were constructed by Easton and Anderson, for the North Sea Canal, in Holland, which were capable of delivering 670 tons of water per minute to a height of 5 feet; while the Gwynne pumps employed to drain the Ferrarese marshes in Italy, at the junction of the Po di Volano and the minor rivers of lower Lombardy, are capable of a combined delivery of 2,000 tons of water per minute.

A large variety of "rotary pumps," although not involving the principle of centrifugal action, but highly efficient as "low lift" pumps, are represented by the turbine pumps, and the screw pumps. One of the last named type was constructed at Milwaukee to flush the sewage-polluted waters of the Milwaukee River, in 1889. It has a screw wheel 13 feet in diameter, which, revolving at a rate of 60 revolutions per minute, delivers 550,000 gallons of water a day on a lift of 4 feet. This water is forced through a brick-lined tunnel 12 feet in diameter, and 2,500 feet long.

"Impulse pumps" operated by the impact of air compressed by a falling column of water or other means, or by the force of a moving column of water suddenly arrested, are represented

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by numerous machines, of which the Shone ejector pump, employed to lift sewage, is the best example of the first, and the hydraulic ram, of the second. In the ejector, the compressed air rushes in from the air compressor at the central station and displaces the sewage in the receiving chamber, the falling sewage automatically shutting off the air supply when the chamber is empty.



Hydraulic Ram.

The hydraulic ram, first designed by Whitehurst, a watchmaker of Derby, England, in 1772, and subsequently perfected by Montgolfier, the famous French balloonist, in 1796, consists of a supply pipe (a); an air-chamber (b) attached to the upper side of the pipe (a), and fitted with a valve (c) at the pipe opening; a valve (d) at the end of the supply pipe, and a vertical pipe (e), connected to the air-chamber, through which the water is raised to the desired elevation. The device operates as follows: The valve (d) is made just heavy enough to descend and open the lower end of the pipe (a) when the water filling the pipe is at rest. Now assume that this valve is open, allowing the water in (a) to run out. This water gradually acquires additional momentum, which finally carries the valve up against its seat and closes the outlet. The water in (a) is thus brought to a state of rest and a part of it enters the air-chamber (b) through the valve (c). But, the instant the water in (a) is brought to a state of rest, the valve (d) descends, opens the outlet, allows the water to run out, and is again closed by the increasing pressure, bringing the water to rest and forcing some more of it into the air-chamber, thence through the pipe (e) to the point of delivery. The action of the valve (c) prevents the return of the water from the air-chamber to the pipe (a). This device is of simple construction, may be adapted to numerous locations in every country, and will operate automatically and continuously, without any attention whatever, so long as the surface of the water at the source of supply is kept at the same elevation, so as to insure a uniform pressure against the valve (d). When the perpendicular distance from the source of supply to the valve (d) is small, and the water is required to be raised to a comparatively great height, pipe (a) must be made of sufficient length to prevent the water from being forced back into the source of supply when the valve (d) closes. It is also necessary to maintain the supply of air in the air-chamber, which in time, under the great pressure, becomes depleted by being incorporated with the water. In small rams a sufficient amount of air enters through the valve (d), but in rams of considerable size a small "snifting valve," attached to another chamber immediately below the air-chamber, automatically supplies the additional air whenever it is necessary.

Bibliography.—For further information con-

sult: Barr, 'Hydraulic Machinery' (New York 1897); Ewbank, 'Hydraulic and Other Machines' (New York 1876); Hood, 'Water-Supply and Irrigation Papers' (United States Geological Survey, No. 14, Washington, D. C., 1898); Turneaure, 'Water Supply'; The 'Scientific American Supplements' and the various engineering magazines and periodicals. Also see articles under AIR PUMP; AIR COMPRESSORS; FIRE ENGINES; STEAM ENGINES; TURBINE; TUNNEL; WATER MOTORS; WATER WHEELS; WATERWORKS.

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Pumps, Compressed Air. During recent years much progress has been made in the art of pumping water by compressed air. At first all systems of lifting water or liquids by means of compressed air were deemed extravagant, but the development of various systems has been such that water may be pumped with marked economy and rapidity by compressed air.

Plunger Pump.—The direct-acting piston plunger pump, of simple or duplex type, is operated with little economy in steam consumption. It is one of the most uneconomical devices known. One hundred and fifty pounds of steam per horse-power per hour is about a fair figure to take for this machine. Experiments have shown that under average conditions hardly 50 per cent of the indicated horse-power of the driving cylinder is utilized in the pump cylinder, the rest being absorbed partly by the engine as machine friction and particularly by the friction of the water in passage through valves and chambers.

The plunger pump consists essentially of two parts, an air end and a water end. The working fluid, which must either be steam or compressed air, operates a piston which transmits its energy through the piston rod which, in turn, causes the pump plunger to reciprocate and thereby pump water. A simple and efficient method for pumping by air in the plunger system is known as the "return pipe" or "closed circuit" system. In this the same air is used over and over again, the exhaust from the pumps being piped back to the compressor under a limited back pressure. In this case the compressed air is a transmitter of power just as a belt or transmission rope, but the air never wears out, may be carried to any distance and at any angle, has little inherent friction, and possesses the highest efficiency in transmission. The system eliminates all trouble from freezing since the air is used repeatedly and moisture once removed cannot be returned. While it requires two pipe lines instead of one, the pipe cost is frequently less because of the smaller pipe size permitted. The pump cylinders will be smaller because of the higher mean effective pressure, and the losses in clearance, often enormous, are entirely eliminated. The great economy in this system is secured in compression, since the scheme is based upon the well-known fact that the greatest losses in compression are thermodynamic, which losses are exaggerated at the lower pressures. For example, 13.42 horse-power will compress 100 cubic feet of free air to 60 pounds pressure, starting at atmospheric. This same energy will compress 100 cubic feet of free air to 350 pounds,

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when beginning compression at 60 pounds, giving on the return pipe system 200 pounds available pressure with 60 pounds back pressure. A reheater on the pump will secure additional economy. Losses through leakage and transmission are supplied by a small "booster" compressor.

Another method of securing high economy is to employ compound or triple pumps, reheating the air after each expansion. This may reduce the air consumption to $\frac{1}{2}$ or $\frac{1}{3}$ its value in the simple pump of the same capacity. In some cases this same result may be secured by the use of three pumps in series, reheaters being used as before after each expansion and the exhaust from one pump being supplied to the next, with a larger air cylinder.

Displacement Pumps.—The displacement pump is almost the essence of pumping simplicity and, if its first promises were borne out, it would be a most powerful factor in pumping problems. As it is, within its recognized field, it has shown a fitness which qualifies it especially for the work. In brief, it consists of two barrels or cylinders which are filled and discharged alternately—the charge in each cylinder being directly discharged or displaced by the admission of the required volume of compressed air through a valve automatically controlled.

The fundamental requirement is a complete submergence of three to six feet. The cylinders are filled at no expense of power and discharged with a minimum of friction losses. Dirt, sand, or grit will not interfere with its operation. Such a pump starts and stops automatically and uses air exactly in proportion to the amount of water discharged. It will run for weeks without attention and requires practically no repairs. Standard sizes have capacities up to 1,500 gallons per minute.

The height to which these pumps will lift water is limited only by the air pressure used, and by an arrangement of several pumps in series almost any height may be attained with ordinary moderate air pressures. In mine work the displacement pump is especially useful in handling accumulated water in sumps, dips, entries, etc. It is also peculiarly effective in subways and tunnels, in automatically discharging the seepage or leakage water which accumulates. It may also serve in the basement of factories and warehouses which are subject to occasional inundations by floods or high water. The same apparatus, but in slightly modified form, is employed for elevating acids and heavy chemical solutions or for pumping marl, paints and other semi-fluids. In this case the air valve is so located that it is not affected by contact with the liquid or by the corrosive fumes arising therefrom. The capacity of the displacement pump is determined by the size of the cylinders or chambers and the volume of air available. Employing air at ordinary pressure from a common single stage air compressor with a lift not exceeding 250 feet, the efficiency of the displacement pump is higher than that of the usual direct-acting plunger pump under the same conditions of lift and pressure. There are three distinct types of these pumps known as the Latta-Martin, Halsey, and Harris or "return-air."

The Latta-Martin system employs two tanks, side by side, with a valve arrangement

controlling the admission and discharge of water and air. In operation the pump is completely submerged and one cylinder fills by gravity while air is forcing out the water from the other. When this cylinder is empty, the air is automatically released, water enters and compressed air is applied to empty the other cylinder. The discharge water flows continuously.

The Halsey system employs a single tank and must be submerged to insure good operation. The tank fills by gravity, and as the water enters it causes the float to rise, which, when near the top of the tank, drops a valve and permits the influx of compressed air to discharge the water. The flow of water is intermittent. Neither the Latta-Martin nor the Halsey system uses compressed air expansively, and as a result there is considerable energy lost.

The "return-air" system overcomes the difficulty of not employing air expansively and in it no floats and no air valves, outside the engine room, are employed and the same air is used over and over again, thus eliminating the effect of clearance. This system employs two tanks and its operation consists in brief of turning air out of one tank and forcing it into the other, and in so doing will draw water into the former and force it out of the latter. The charge of air in the system is so adjusted that when one tank is empty the other is full, and at that moment the switch will be automatically thrown, reversing the pipe action and thereby reversing the action of the tanks. Of all systems of pumping, the Harris is certainly the most economical and efficient. Using the air expansively, all the inherent energy of compressed air is used, and no mechanism being submerged, there is no chance for the system to become inoperative due to breakage or a demand for repairs. This system may be employed for pumping mixtures of sand and water, and operates with a marked degree of economy and reliability.

Power Driven Pumps.—The greatest advantage in the use of the power driven pump, when the air is the driving fluid, lies in the fact that it permits the expansive use of the compressed air, resulting in a considerable saving and economy. Power pumps consist essentially of expansive air engines, which may be either direct connected, belted or geared to some form of duplex or triplex plunger pump, or to the simple, compound or turbine types of centrifugal pump in its various forms. Compressed air is supplied to the air engine from some distant air compressor and this air engine, when specially designed for the use of air involving considerations of air valves and low clearance, operates with efficiency and economy. Where the magnitude of the operation justifies it, the use of the "return pipe" system with expansive engines will, in connection with reheaters, secure the very highest efficiency.

Air Lift.—Opinions differ as to the theory of the air lift. A common air lift is one where we have a driven well in which the water is approximately near the surface. We place in this well a large pipe for the discharge of the water. This is known as the "eduction pipe." This pipe does not touch the bottom of the well, but is lifted above it so as to admit freely the water through its lower end. Alongside this pipe, either on the outside or within, is a second but smaller pipe, properly proportioned

and intended to convey compressed air to a point near the bottom of the eduction pipe. The air pipe is connected with an air receiver on the surface, which is in or near the engine room in which free air is compressed. Before turning on the air the conditions in the well show water at the same level on the outside and inside of the eduction pipe. At the first operation we must have sufficient air pressure to discharge the column of water which stands in the eduction pipe. This goes out *en masse*, after which the pump resumes a normal condition, the air pressure being lowered and standing at a point corresponding with the normal conditions in the well. This is determined by the volume of water which a well will yield in a certain time and the elevation to which the water is discharged. It was first supposed that in all air lift cases the water was discharged because of the aeration of the water in the eduction pipe due to the intimate commingling of air and water. Bubbles of air rising in a water column not only have a tendency to carry particles of water with the air, but the column is made lighter, and, with a submergence or weight of water on the outside of the eduction pipe there would naturally be a constant discharge of air and water. This is known as the Frizell system, and where the lifts are moderate, that is, where the water in the well reaches a point near the surface, it is very likely that the discharge is due to simple aeration.

Most air lift propositions are deep well cases, that is, the water is lifted a distance greater than 25 feet. Aeration will not expel such water, so the idea of piston-like layers of air and water is developed. The economy of the air lift system is in direct proportion to the capacity of the well to form these piston-like layers, and the reason why they are formed is that after the first discharge, there is kept up a constant struggle between the air under pressure and the head of water on the outside of the pipe, each one seeking to enter the lower end of the eduction pipe.

When the air pressure is greater than that due to the head of water, a certain volume of compressed air is admitted into the eduction pipe. The water is at that time moving rapidly, that is, its momentum has been established. The air takes up this velocity and goes upward with the water. If a sufficient quantity of air has been admitted in proportion to the diameter of pipe, and if there is a sufficient pressure in this pipe to prevent the free discharge of the air, it is readily seen how this bubble of air spreads itself across the diameter of the pipe in a piston-like condition. The reason why this piston is not elongated and continuous is that the free discharge of the air, aided by the velocity with which everything in the eduction pipe is moving, causes a fall in the air pressure just sufficient to allow the water head to press the water into the air space, or the open end of the eduction pipe. In other words, as the air pressure is slightly lower, the water pressure, which was nearly equal to the air pressure, becomes a little greater and the piston-like layer of water enters the pipe, shutting off the air. This "chunk" of water rises in the eduction pipe with velocity equal to that of the air, and as it has plugged off the air nozzle, there is a momentary rest, during which the air has a chance to accumulate greater pressure, and just

as soon as this pressure overcomes that of the water, the conditions are reversed and another "chunk" of compressed air is discharged into the pipe, shutting off the water for an instant. This process is continuous and as regular as the movement of a pendulum.

As these "chunks" of air approach the surface, they are gradually enlarged, because of the reduced load upon them, and it is likely that before they reach the surface there is a general breaking up of the piston-like layer condition. The Pohlé system of air lift is probably the best known. Sand, grit and small stones are no obstacles in the satisfactory operation of this system. As a matter of fact, in many instances, the capacities of the wells have been increased by opening up the well more thoroughly, by removing sand. Water pumped by this system is purified, due to aeration. The system is not limited as to the quantity of water that can be handled. This will depend upon the capacity of the wells to furnish the water. The height of the lift is unlimited, as well as the submergence.

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Pun, a play upon words alike or similar as to sound, but different as to sense. The pun has been familiar to all literatures, and in ancient times was used even in serious context. This was true also in England of the 17th and 18th centuries. Puns are met with in the tragedies of Shakespeare; in the works of the quaint Fuller; in the discourses of Bishop Andrewes. The divines of colonial America did not lack for them. Mathey Byles won his reputation for wit chiefly through the appositeness and felicity of his puns. Thus, being a sturdy loyalist, he was for a time kept under surveillance by a sentinel whom he called his "observe-a-Tory." A parishioner called upon him, and Byles, noting his ulcerated jaw, sent him to Copley, the artist, to have his tooth drawn. Among famous English punsters may be cited Sydney Smith, Lamb, Theodore Hook, Wilberforce and, above all, "Tom" Hood, most inveterate and happy of the coterie, who even remarked of a certain undertaker that he appeared anxious to "win a lively Hood." The pun has frequently been derided as an unworthy form of wit. John Donne is reported to have said that "He who would make a pun would pick a pocket"; and Holmes, in the 'Autocrat,' after denouncing verbicide, gives a pyrotechnic display of excellent puns. It is true, however, that the pun has found advocates in divines, philosophers, statesmen and literati. Many puns convey a weight of meaning which could hardly be secured by sentences of paraphrase.

Punch, a well-known English comic weekly, the most famous journal of the kind. The success of Philipon's Paris 'Charivari' induced a staff of several Englishmen—some, as Douglas, Jerrold, Thackeray, and John Leech, since famous—to organize for the publication of a 'London Charivari,' of which whole pages of text had been set up, when the scheme collapsed. This undertaking had, however, some indirect influence on the subsequent 'Punch.' The idea of 'Punch' appears to have been due originally to Ebenezer Landells, a Northumbrian wood engraver and draughtsman, and to have

been developed by Henry Mayhew, a brilliant humorist of the time. "Mr. Punch" was the traditional jester of the puppet-show transformed into "the laughing philosopher and man of letters; the essence of all wit, the concentration of all wisdom." As finally agreed, Mayhew, Mark Lemon, and Stirling Coyne were to be co-editors, Landells was to find drawings and engraving, and Douglas Jerrold and Gilbert à Beckett were to be among the outside contributors. The first number appeared on 17 July 1841. In two days two editions, each of 5,000 copies, were sold out. After some early vicissitudes, "Punch" became an English institution. A list of its writers and artists includes many famous names besides the jovial Lemon and the caustic Jerrold; Thackeray, "Tom" Hood, Charles Lever, "Tom" Taylor, Cuthbert Bede, Horace Smith, Shirley Brooks, F. C. Burnand, Artemas Ward, G. A. Sala, H. W. Lucy; John Leech, H. K. Browne ("Phiz"), Sir John Tenniel, George Du Maurier, Stacy Marks, Sir John Millais, Linley Sambourne, and others. The editors have been: Mark Lemon, 1841-70; Shirley Brooks 1870-4; "Tom" Taylor, 1874-80; Sir F. C. Burnand, 1880-1906; and Owen Seaman, 1906—. "Punch" has done much to laugh out of court various shams, fads, affectations, and forms of ostentation. In British politics it has remained wholly free from party bias. The present application of the word "cartoon" originated with "Punch," the occasion being the first great exhibition of cartoons for the Houses of Parliament (July 1843), when Mr. Punch appeared with a rival series of sarcastic designs. "Punch" has sometimes been unfairly attacked for its insularity. Consult: Spielmann, 'The History of "Punch"' (1895); 'An Evening with Punch' (1895), selections from the first 50 years; A. W. à Beckett, 'The à Becketts of Punch' (1903).

Punch, a beverage, commonly composed of wine or spirits, water, lemon juice, and sugar, with occasionally an addition of some spice, as nutmeg or cinnamon. These are usually mixed in the requisite proportions in a large bowl made for the purpose—hence called the punch-bowl. The beverage is compounded as follows: Squeeze the juice out of three or four lemons into a jug, adding thereto the peel of one lemon cut in slices, 12 ounces of lump sugar, and three and a half pints of boiling water; infuse this mixture for half an hour, then pour into the punch-bowl, and add of rum and brandy rather less than a pint of each. Varieties of punch are called after one of their principal ingredients, gin, milk, orange, raspberry, tea, wine, etc. Punch was introduced into Great Britain from India, and it appears to be so called from the Hindu *panch*, five, which is the usual number of the ingredients.

Punch. See METAL-WORKING MACHINERY.

Punch and Judy, in Great Britain and some European countries, a well-known puppet-show frequently exhibited in the streets. The show of Punch and Judy derives its origin from the Neapolitan Punchinello, but many of its features are purely English. The earliest account of the adventures of Punch and his wife, Judy, is found in a ballad, the date of which does not appear to be anterior to 1795. This account corresponds pretty closely with the representa-

tions given in our streets. The show embodies a domestic tragedy, followed by a supernatural retribution, the whole of which is treated in a broadly farcical manner. Punch himself is represented as short and thick-set, with an immense hump upon his back, a wide mouth, long chin, and hooked nose, and wearing a three-pointed cap. His wife, Judy, who is in some respects his counterpart, and his dog, Toby, are important characters in the performance. See also PUPPET-SHOWS.

Pun'cheon, a liquid measure of capacity containing from 84 to 120 gallons. See WEIGHTS AND MEASURES.

Punchinello, pŭn-chĭ-nĕl'ō (from *pulcinello*), an Italian mask or marionette. The Abbate Galiani derives the name from a misshapen but humorous peasant from Sorrento, who had received it (about the middle of the 17th century) from his bringing chickens (*pulcinelle*) to market in Naples, and who, after his death, was personated in the puppet-shows of the San Carlino theatre, for the amusement of the people, to whom he was well known. See also PUPPET-SHOWS.

Punctuation, from the Latin *punctus*, "a point," is the term used to designate the use of certain points, or marks, for the purpose of separating words from each other in sentences and parts of sentences. The convenience of such separation is too obvious at this time to need support by argument, but the fact is, nevertheless, that for many centuries after writing had first been used there was nothing to indicate the pauses, or divide a book into sentences. No attempt to punctuate is apparent in the earlier manuscripts and inscriptions of the Greeks. It was in Alexandria that punctuation originated, when that city was the centre of ancient learning. The open space to the left of a line which indicates the beginning of a paragraph made its appearance on papyri at Alexandria. The early signs intended for punctuation were at first used in poetry only, to enable readers to comprehend the meaning hidden in obsolete words and involved and difficult verses. Ages passed, however, before any form of punctuation became general, and it was not until the 9th century after Christ that the division of sentences by full-points and colon and semi-colon marks, took place. The comma was the same as to-day, a large dot or double dot indicated the full-stop, and a high dot stood for a colon or semi-colon.

Modern punctuation has no hard and fast rule, and this is especially the case in English, writers of standing exemplifying the broadest latitude in this respect. Some long sentences in standard works are carried through without a comma, while in books of equal repute commas are plentifully used where no pause is apparent. Properly speaking a comma signifies a slight turn in a sentence; the semi-colon is used where there is a change too important for a comma, and the full-point or period marks the close of a sentence. The colon is not often used, and when it is used it is where, as a rule, a full-point would be better. This may also be said of the semi-colon. There is a growing tendency to uniformity in the use of punctuation.

Pun'dit, or **Pandit**, an Indian title for men who devote themselves to the pursuit of learning, especially on religious subjects. It corre-

PUNIC WARS — PUNJAB

sponds with the modern title of "Doctor." It is especially applied to certain men who in the 19th century after being instructed by the English in the science of geodesy have explored and surveyed Tibet, and other areas of Asia generally inaccessible to Europeans. The most notable of them were Mohammed i Hamid, who went (1863-4) over the Karakoram Pass to the Yarkand River; the famous Naing Singh, who, between 1865 and 1875, brought back valuable results from his travels in Tibet, and discovered the northern springs of the Indus; Mirza Sudja, who (1868-9) crossed the Little Pamir to Kashgar and Ley; Haider Schah, who in 1870 made an expedition to Faizabad in the valley of the Oxus, and later explored the mountain ranges between Cabul, Bokhara, and East Turkestan. Consult: Garbe, 'Indische Reise-skizzen' (1889).

Punic (pū'nīk) **Wars**, in ancient history, the general name applied to three great wars between the Romans and the Carthaginians. The first (264-241 B.C.) was for the possession of Sicily, and ended by the Carthaginians having to withdraw from the island. The second (218-202 B.C.), the war in which Hannibal gained his great victories in Italy, was a death struggle between the two rival powers; it ended with decisive victory to the Romans. The third (149-146 B.C.) was a wanton one for the destruction of Carthage, which was effected in the last-named year.

Pū'nica. See POMEGRANATE.

Pun'ishment, a term which originally signified pain inflicted on or endured by a person as a satisfaction or atonement by him for some offense which he had committed; it embodied, in fact, the idea of retaliation, and this appears to have been the earliest notion of punishment which most nations possessed. It occurs among the early Greeks; the Romans recognized it in the laws of the Twelve Tables; and it was the principle of the well-known provision of the Mosaic law, "an eye for an eye," etc. In this country punishment by death is called *capital punishment*. See CAPITAL PUNISHMENT; LAW, CRIMINAL; PRISON; etc.

Punjab, pūn jāb', or **Panjab** (Persian, "Five Waters"), an extensive territory in the north-west of Hindustan, formerly under the dominion of the Sikhs, but in 1849 annexed to British India. It is so called from its position, being intersected by the five great rivers which unite to pour their waters into the Indus. In 1901 the northwestern part of the Punjab was separated to form a chief commissionership under the government of India (see NORTHWEST FRONTIER PROVINCE). The lieutenant-governorship as thus limited is bounded on the east by Kashmir, Tibet, and the river Jamna; on the south by Sind and Rajputana, the river Sutlej being in part a boundary river; on the west by Baluchistan and Northwest Frontier Province; on the north by the Northwest Frontier Province. For administrative purposes it is divided into four divisions (Delhi, Jalandhar, Lahore, and Rawal Pindee). Lahore is the capital, with a population of 202,964. Delhi has a population of 208,575, while Amritsar, the sacred city of the Sikhs, has 162,429. Simla, the mountain capital, is within the Province, and is the residence of the viceroy during the hot season. Murree is

the summer headquarters of the military command. The total area of the province is 97,209 square miles, with a population of 20,330,339. The area of the Native States is 38,299, with a population of about 4,500,000.

General Description.—The province of the Punjab is a triangular tract of land between the Sutlej and the Indus, and, with the exception of the hill country on the slopes of the Himalayas, it is a great alluvial plain. On the northeast side is the margin of the Himalayas, on which there are beautiful sanitarium, or hill stations:—Simla (the mountain capital of India), Dagshai, Sabathu, Kassauli, Dharmasala, Dalhousie, and Murree, the military headquarters of the province. The country between Jhelam and the Indus is known as the salt range, as it contains inexhaustible mines of rock salt which have been worked for many centuries. It is abundantly irrigated by six rivers. These rivers (proceeding from west to east) are the Indus, the Jhelam (ancient *Hydaspes*), Chenab (ancient *Acesines*), the Ravi (ancient *Hydraotes*), the Beas (ancient *Hyphasis*), and the Sutlej (ancient *Hesudrus*). The Jhelam and Chenab unite their waters, and then are joined by the Ravi; the united stream is then augmented by the Sutlej, which has previously received the Beas. The combined waters of these rivers form the Panjnad, which joins the Indus near Mithankot. The rivers of the Punjab divide it into five districts, or *doabs* (countries between two rivers): namely, the Sind-Sagar Doab, between the Indus and Jhelam; the Jech Doab, between the Jhelam and Chenab; the Rechna Doab, between the Chenab and Ravi; the Bari or Manja Doab, between the Ravi and Beas; and the Jalandar Doab, between the Beas and Sutlej. Of these the first is by far the largest, but also the most sterile and least inhabited, abounding with bare eminences and rugged declivities, interspersed here and there with rich and fertile valleys. The second is mostly level, and has been described as "a sterile waste of underwood," the abode of shepherds, and scantily irrigated; the Rechna Doab is bare and neglected, though susceptible of high cultivation; the Bari Doab, though bare, has a large surface under cultivation, and is the most populous and important of all, containing the large towns of Amritsar, Multan, and Lahore; while the Jalandar Doab is highly cultivated, well peopled, and excelled in climate and productions by no province in India. Speaking generally, the plains east of Lahore are the most fertile, wealthy, and populous of the province, and the granary of the Punjab; while those on the west present a striking contrast. The soil of the level country varies remarkably from stiff clay and loam to sand, mixed with each other in variable proportions, and with vegetable matter; besides which, carbonate and sulphate of soda are sometimes mixed with it in such quantities as to render the land almost worthless. The mineral wealth of the Punjab is almost confined to its rich deposits of rock salt. The climate is hot and dry, and little rain falls, except in the higher country and under the influence of the Southwest monsoon. The part of the province to the east of Lahore can be cultivated in most seasons without irrigation, but owing to this its crops are much more likely to fail from a deficiency of rainfall than those of the western irrigated tracts. The summer heat is

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very great, and in the early part of January sharp frosts are common.

Vegetation, Agriculture.—Wood is scarce, except upon the hills. In the west considerable areas are occupied by date-trees; and palms of other species, banyans, and other trees are found here and there. The area under forests is over 4,250,000 acres. About 28,000,000 acres of the remainder are under cultivation, and over 20,000,000 acres more are available for cultivation. The principal grain crops are wheat, barley, rice, buckwheat and millet, pease, vetches, and mustard; sesamum and other oil seeds, turnips, carrots, onions, cucumbers, and melons. Indigo and sugar are exported. The tobacco plant grows luxuriantly, especially about Multan, and opium has been grown pretty extensively. About 7,750,000 acres are under wheat, and over 750,000 under rice. The total irrigated area exceeds 9,000,000 acres, of which more than half is irrigated by canals. Among the fruits are the date, orange, fig, vine, apple, mulberry, banana, and mango. The live-stock include sheep, cattle, horses, and camels; buffaloes are common.

People.—The population of the Punjab is composed of various races, the chief of which are the Jats, Rajputs, and Pathans. The Jats form the bulk of the agricultural peasantry, and are tall and athletic, with handsome, open countenances, long beards, and fine teeth. The people, generally, are in physical respects superior to those of Bengal. The native states subordinate to the Punjab government are thirty-six in number. Thirty-one are Hindu and five Mohammedan. The most important is Kashmir, the next Patiala. The Mohammedan state of Bahawalpur is the next. The next in order are Kapurthala, Mandi, Sarmur, Faridkot, and Malarkotla. The other states are insignificant in rank and consequence.

Religion.—The religion of the Sikhs, which is the national religion of the Punjab, was founded by Nānak, who was born A.D. 1469. The Golden Temple at Amritsar is the centre of the faith and the guardian of the sacred book known as the *Adi Granth* (see *SIKHS*). By the census of 1891 the distribution of the population according to religious profession was as follows: 12,915,643 Mohammedans, 10,237,700 Hindus, 2,100,000 Sikhs, 53,909 Christians, 45,683 Jains, 6,236 Buddhists, 412 Parsis, 33 Jews, and 30 others. Of the Christian population 27,915 belonged to the Church of England, 12,083 were Presbyterians, 7,113 were Roman Catholics, the remainder being Baptists, Methodists, etc. The American Presbyterian Board of Missions has important stations at Lahore, Ludianah, and Umballa. Lahore is the seat of both a Church of England bishop and a Roman Catholic bishop. The Mohammedans form a very large part of the population of the Rawal Pindee and Multan divisions. The Hindus predominate in the easterly divisions and in the mountainous district of Kangra. The Sikhs reside chiefly in the centre and east of the province and constitute the mass of the gentry. The few Buddhists of the Punjab are almost entirely confined to the small Spito district in the extreme northeast. The Pathans and Baluchis are the most numerous of the Punjab Mohammedans by race, but the Mohammedan strength consists largely in converted Hindus belonging to the Jat and Rajput tribes. The Hindu Jats form a large proportion of the population.

Language and Education.—The chief languages spoken in the Punjab are Punjabi (known as Gurmukhi), Hindi, Sindhi, Jataki, Kashmiri, Pushtu, Persian, and English. Since the country came under British rule elementary education has received much attention. The total number of educational institutions in the Punjab in 1899-1900 was 7,867, with a total of 262,319 scholars. Of the higher educational institutions of the province the following may be mentioned:—the Punjab University at Lahore; Lahore Government College; Oriental College; St. Stephen's College, Delhi; Lahore Medical School; St. Thomas College, Murree; the Khalsa College, Amritsar; Bishop Cotton School, Simla; and the Lawrence Military Asylum, Sanawar.

Manufactures and Trade.—The manufacturing industry of the Punjab is chiefly confined to the larger towns. Amritsar, Lahore, Multan, and Shujabad are distinguished for their silk and cotton fabrics, and the silks of Multan called *kais*, and chiefly used for scarfs, possess a strength of texture and brilliancy of color for which they are much prized in the Indian markets. The shawls of Lahore, too, rank only second to those of Kashmir. Brocades, tissues, and carpets resembling the Persian are also manufactured in the capital. In the east of the Punjab white cotton goods are prepared of a stronger and more durable texture, as well as cheaper, than those of British manufacture. The Punjab enjoys from its position an extensive transit-trade. The imports comprise sugar, spices, and other groceries, dye-stuffs and cottons, woolen and silk fabrics, metals and metallic utensils, cutlery, precious stones, ivory, glass and cochineal, asafoetida, safflower, fresh and dried fruits, wool, horses, etc. The exports—partly of home produce, partly in transit—comprise grain, *ghee*, hides, wool, silk and cotton fabrics, carpets and shawls, raw silk and cotton, indigo, tobacco, hardware, horses, etc.

Government and Revenue.—The province is under a lieutenant-governor, assisted since 1897 by a legislative council of nine members. The most important item of revenue is the land-tax, which, on the average, yields a net revenue, after deducting charges, of nearly £2,000,000; besides there are excise duties on spirits and drugs, duties on stamps, etc. The financial condition is so favorable that there is often a clear surplus of revenue over expenditure of £2,500,000. About one-half of the whole cultivated area of the Punjab is tilled by owners, and about one per cent. by tenants paying a nominal or no rent. Of the remaining area one-fifth is cultivated by occupancy tenants, and the rest is held by tenants-at-will, a class increasing in numbers from year to year. Rents vary from 5 annas to 40 rupees per acre, the average being about 2-3 rupees. On about two-thirds of the land held by tenants-at-will the rent is wholly or partly paid in kind, and the average rent payable in kind is for the whole province about two-fifths of the produce. Nearly 5,000,000 acres are under mortgage.

Army and Police.—The Punjab forms a military district called "The Northern Command," under a lieutenant-general with headquarters at Rawal Pindee. The military authority of this officer extends to the Northwest Frontier Province. The military cantonments are Rawal Pindee, Peshawar, Noroshera,

Abbottabad, Sialkor, Jhelum, Lahore, Jullundur, Sirhind, Umballa, Ferozepore, Kohat, Bannu, and Murdan under a lieutenant-general. The military force stationed in the Punjab in 1900 consisted altogether of 68,806 men. Of cavalry there were 11,893, of infantry 50,504, of artillery 6,120, with some engineers, etc. There were thus more troops in the Punjab than in any other division of India. The police force is stated to be in a most effective condition. It numbers about 20,000 men, divided into two divisions, the Trans-Sutlej and the Cis-Sutlej. Almost all the police are armed either with swords or guns. The Punjab has a chief court with five judges, two of whom are natives—and four temporary judges.

History.—The Punjab plays an important part in the history of Hindustan and British India. It was invaded in 327 B.C. by Alexander the Great, who defeated Porus at Mong in Gujerat and overran the whole country. In 1022 it was overrun by the troops of Mahmūd of Ghazni, whose successors held the country for 170 years, making Lahore the seat of their government. In 1193 it passed by conquest into the hands of Mohammed Ghori, and Delhi became the capital. After his death the country was ruled by a succession of turbulent chiefs, principally Afghans, till at length in 1526 Baber, the founder of the Mogul Empire, having obtained possession of the country, ascended the throne, and established a dynasty whose sway prevailed for about two centuries, during which the Sikhs were rising into importance. In 1738 Nadir Shah overran the Punjab, and in the following year he defeated the Mogul army at Karnal and sacked Delhi. The Sikhs were utterly defeated by the Afghan conqueror Ahmed Shah Durani in 1762, and the Moguls nominally ceded the Punjab to him. The Durani dynasty maintained its ascendancy till the beginning of the 19th century, when the Sikhs under Ranjit Singh began their career of conquest. In 1818 this renowned chieftain stormed Multan and took Peshawar—in the following year conquering Kashmir and Derajat west of the Indus; and in 10 years he succeeded in establishing his power over the whole country. In 1839 Ranjit Singh died. His son Khorak Singh quietly succeeded, but died of a decline a few months after his father, on which Shere Singh, a natural son of the great Ranjit, assumed the sovereignty, but was assassinated 15 Sept. 1843. Dhulip Singh, the reputed son of Ranjit Singh, succeeded his brother. This young prince was converted to Christianity and retired on a princely pension to England, where he died. But from the close of 1843 to the period of its annexation to British India the government was in abeyance, or, what is worse, in the hands of an ignorant, bloodthirsty, rapacious, and insubordinate army. At length it became manifest that the Sikhs of the Punjab were preparing for an irruption into the territories protected by the British on the east of the Sutlej. In the end of December 1845, the Sikh forces passed the Sutlej into the territories protected by the British, with a most formidable train of artillery, but they found themselves completely worsted after the hard-fought actions of Mudki, Ferozeshah, Aliwal, and Sobraon. Lahore and other stations were afterward occupied by British troops; the Jalandhar Doab, between the Sutlej and Beas, was

permanently ceded to the British; and the province of Kashmir, and the other provinces of the Himalayas, were vested in the Rajah Gholab Singh. In 1849 a conspiracy between several disaffected chiefs and the Afghans resulted in further hostilities against the British, Multan being the centre of their operations. The indecisive battle of Chillianwalla was followed by the capture of Multan in January, and the victory of Gujerat in February 1849, since which period the former territories of the Sikhs have formed an integral part of the British Empire. The most important subsequent event in the history of the province was the Indian Mutiny, when the Sikhs were loyal to the British government, and the present Sikh regiments of the British native army form the most important section of the military strength of the empire, the Sikhs and the Gurkhas being esteemed by many critics the finest soldiers in the world. After the suppression of the Mutiny the province was erected into a lieutenant-governorship under Sir John Lawrence, the distinguished statesman.

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Punj'nud, or Panjnad ("the five rivers"), a stream of the Punjab, formed by the Sutlej, Beas, Ravi, Chenab, and Jhelam, whose waters it carries to the Indus (q.v.), about 400 miles from the sea near Mithankot. The Punjnud bounds Punjab and Bahawalpur in part of its course.

Punk'ah, a large fan used in India and other hot countries for ventilating rooms. It consists of a movable frame of wood covered with canvas and suspended from the ceiling. It is pulled backward and forward by means of a cord, and thus causes a current of air in the apartment.

Punnah, pūn'a. See PANNA.

Puno, poo'nō, Peru, (1) town, capital of the department of Puno; on the west shore of Lake Titicaca, 12,870 feet above sea-level, and 90 miles east by south of Arequipa. It has two churches, a college, and a hospital. A railway runs to Arequipa and to Mollendo on the Pacific. Pop. 6,000. (2) The department of Puno; area, about 41,198 square miles, is mountainous. The principal crops are potatoes and barley, but it is particularly distinguished by the extent of its pastures, cattle raising being the chief occupation. Its principal exports are the wool of the sheep, llama, alpaca, and vicuña, and some cascarilla bark from the valley of Carabaya. Pop. about 540,000.

Punt, poont, an ancient country on the Red Sea, whether in Asia or Africa is disputed. The country is mentioned a number of times in the Egyptian hieroglyphics, and such records show that the Egyptians obtained from Punt

ostrich feathers, leopard skins, gold, incense, ivory, precious woods, and various ornaments. There are good reasons for locating Punt where is now Somali Coast and Abyssinia. Accounts are given of journeys to Punt, undertaken by command of monarchs. Queen Hatshepsut sent thither a whole fleet, and the account of the voyage, the persons and places seen in Punt were recorded on the walls of the Temple of Deir el-Bahri. Consult: Müller, 'Asien und Europa'; Naville, 'Deir el-Bahri'; Erman, 'Life in Ancient Egypt.'

Punt, an oblong flat-bottomed boat used for fishing and shooting in shallow waters. The most common mode of propulsion is by pushing with a pole against the bottom of the river, or stream, a process which is hence called punting.

Punta Arenas, *poon'tā ā-rā'nās*, or **Sandy Point**, Chile, port and capital city of the territory of Magellan, at the extreme end of Patagonia (lat. 53° 10' S.), and lying in a plain bounded by the rivers Las Minas, on the north, and La Mano, on the south, with wooded hills back of the river. The city is Chile's only free port and is a coaling station for steamers passing through the Strait of Magellan. The surrounding country produces rye, barley, potatoes, etc., and the forests supply timber which is exported to the Falkland Islands. The seal-fisheries are considerable. The city has banks, stores, hotels, and an opera house. Pop. (est.) 6,400. The site was made a penal colony in 1843, and a town was founded in 1849.

Punxsutawney (*Punk-sōō-tā-nŷ*), Pa., city in Jefferson County; situated on Mahoning Creek and on the Pennsylvania & N. W., the Buffalo, Rochester & Pittsburg, and the Buffalo & Susquehanna R.R.'s; about 70 miles east of Pittsburg. It is the business centre of a great bituminous coal and coke region and the headquarters of the second largest producers of bituminous coal and coke in the United States. There are also large iron furnaces and numerous smaller industries. Punxsutawney is an Indian name signifying 'Mosquitotown' or 'Gnatopolis,' the Indian word for blood-sucking insects of the genus *Culex* being 'ponki.' It was organized into a borough in 1849. Its growth since 1890, when it had a population of 2,792, has been rapid. Pop. (1900) 4,375; (1910 census) 4,900, and with the borough of Clayville immediately adjoining it on the west, about 8,300. W. O. SMITH.

Pupa, the name applied to the second stage in the metamorphosis of insects. In the typical complete or holometabolic insects, exemplified by beetles, the *Lepidoptera*, flies, etc., the pupa stage is marked by quiescence and rest, and thus presents a contrast to the preceding and active larval stage. During the pupa stage the elements of the larval form are being remodeled into that of the *imago* or perfect insect, which in due time emerges from the pupa case. An insect may remain in the pupa stage from a few hours or days to weeks, months, or even years.

The pupæ of the hemimetabolic insects, or those which undergo an incomplete metamorphosis (such as grasshoppers, locusts, bugs, etc.), are called nymphs, and differ from the perfect insect, which they resemble in form, chiefly in the absence or rudimentary nature of the wings. These latter structures in the pupa state of hemimetabolic insects may generally be per-

ceived to be in course of formation, the perfect insect or imago state being characterized simply by the full development of the wings. See INSECTS; METAMORPHOSIS.

Pu'pin, Michael Idvorsky, American scientist and inventor: b. Idvar, Hungary, 4 Oct. 1858. He came to America in 1874, was graduated at Columbia in 1883, and as the first American holder of the John Tyndall Fellowship of Columbia studied physics and mathematics at Cambridge University and under the famous von Helmholtz at the University of Berlin, here taking his degree of Ph.D. He returned to teach at Columbia, was appointed adjunct professor of mechanics there in 1892, and professor of electro-mechanics in 1901, which position he now (1904) holds. He is the inventor of an improvement in the telephone by means of which it is confidently expected telephoning across the Atlantic will soon be rendered practicable. Professor Pupin first announced the theory underlying his invention in March 1899, and brought his system to such perfection that in 1901 it was acquired by the Bell Telephone Company and by German telephone interests for practical trial. In June 1903 the device had been found, in Germany, to operate successfully over a cable more than 260 miles in length, and its applicability to submarine cables was considered established. His invention not only makes it possible to telephone much further than before, but renders all messages more distinct. It consists, essentially, of self-inducting coils of wire placed at intervals about the wire which transmits the sound, thus preserving the vibrations a greater distance. He has published: 'Thermodynamics of Reversible Cycles in Gases'; etc.

Puppet-shows, an amusement or entertainment popular in Europe. One of the most common classes of puppets is called, in French, *marionnettes*. These are images of the human figure moved by wires or threads on a stage, and made to perform little dramas, the dialogue of which is carried on by the person in concealment, who moves the figures. In the common street performance in England of Punch and Judy (q.v.), however, the performer puts his fingers in the figures. Puppet-shows were common among the Greeks, from whom the Romans received them. Xenophon, Aristotle, Gellius, Horace, and others mention them. Such exhibitions, which are so pleasing to children and the uneducated, naturally passed through various degrees of perfection in different ages, and even now exhibitions of puppets are common in some countries which display great mechanical ingenuity. Clocks often display movable puppets, and it is not unfrequent in Germany to find on ancient town-clocks puppets which move whenever the clock strikes. In 1674 there was a puppet opera at Paris, which met with great applause. At present there are two theatres in Paris for puppet-shows, and they still continue to be performed in several large cities of Italy. In Germany, also, excellent puppet-shows are sometimes seen, but they are there hardly ever stationary, and are not by any means so much patronized as in Italy. There is a puppet-show in the Italian colony in New York, which is much patronized by Americans.

Puracé, *poo-rā-sā'*, a volcano of the Andes in Colombia, 20 miles east of the town of

Popoyan. Eruptions have occurred several times; the town of Puracé at the base of the mountain was destroyed by the eruption of 1827; and the top of the volcano blown off and its height reduced to 15,420 feet by the eruption of 1849. It is still active, and hot vapors issue constantly from the crater.

Puranas, poo-rā'ṇas. See SANSKRIT LANGUAGE AND LITERATURE.

Purbeck (pēr'bēk) Beds, a series of geologic beds or strata consisting of limestones, clays shales and sandstones which in England form the uppermost member of the Jurassic system (q.v.). They are named after the Isle of Purbeck on the southeast coast of Dorsetshire where they are exceptionally well developed and yield among other building stones a limestone, susceptible of a good polish, which is known as Purbeck marble. The "Isle" is in fact a peninsula 12 miles long by 7 miles broad, almost completely surrounded by sea. The Purbeck beds appear in a chalky ridge which traverses the island from west to east.

Purbeck, Isle of. See PURBECK BEDS.

Purcell, pēr'sēl, Henry, English composer: b. London 1658; d. 21 Nov. 1695. He was the son of a musician of the chapel-royal, who left him an orphan in his 6th year. He was admitted a chorister in the king's chapel, where he studied music under choir-master Cook and his successor Pelham Humphrey, and afterward under Dr. Blow. In 1676, when only 18, he was made organist of Westminster Abbey, and six years afterward was appointed to fill the same office at the chapel-royal, St. James. From this period his fame increased rapidly, his anthems and other church music being popular in all the cathedrals of the kingdom; nor were his compositions for the stage and music-room less successful. He composed music, religious, and secular, with equal facility; and with respect to chamber music his compositions superseded all prior productions. Of his numerous works his 'Te Deum' and 'Jubilate' were composed for the celebration of St. Cecilia's Day, 1694. Of his instrumental music a collection was published two years after his decease, and comprised pieces in four parts, for two violins, tenor and bass. Many of his songs were published after his death under the title of Orpheus Britannicus. 'Ye Twice Ten Hundred Deities,' contained in this collection, is considered the finest piece of recitative in the language; while his music in 'King Arthur' has maintained its popularity undiminished till our own day. In 1695, the year of his death, he set to music 'Bonduca,' an opera altered by Dryden from Beaumont and Fletcher; but his chief opera is 'Dido and Æneas' (1680). He was the author of a vast variety of catches, rounds, glees, etc., remarkable both for their melody and for their spirit, humor, and originality. He was buried in Westminster Abbey. A splendid edition of his works is published by the Purcell Society, founded in 1878. An earlier edition of his sacred compositions is that of Novello (1829-32). Consult: Cummings, 'Life of Henry Purcell' (1882).

Purcell, John Baptist, American Roman Catholic archbishop: b. Mallow, County Cork, Ireland, 26 Feb. 1800; d. Brown County, Ohio, 4 July 1883. He came to the United States in

1818, was educated at Mount Saint Mary's College, Emmitsburg, Md., received minor orders, and later studied at Saint Sulpician's College in Paris. He was ordained in 1826 and in 1827 appointed to the chair of philosophy in Saint Mary's College, of which he became president in 1828. In 1833 he was consecrated bishop of Cincinnati, and at once set about the improvement of the diocese under his charge, and in 1846 the number of churches under his control had increased from 12 to 70, the number of Roman Catholics from 6,000 to 70,000. He founded schools and academies, built a convent for the Ursulines, and in 1847 the diocese of Cleveland was formed out of that of Cincinnati at his request and placed in charge of another prelate. In 1850 he was made an archbishop and in 1851 received the pallium from the Pope's own hands. He founded Mount Saint Mary's of the West, destined to become one of the leading theological seminaries of the country, and in 1855 presided over his first provincial council. New sees were formed from his diocese in 1868, but though their creation had limited his diocese in extent, it still contained 140,000 Roman Catholics. He attended the Vatican Council in 1869 and celebrated his golden jubilee with great rejoicing among his people in 1876. In 1879, however, his hitherto unbroken prosperity was interrupted. His brother Edward had been appointed his vicar-general and the financial affairs of the diocese had been left by the bishop entirely in his brother's care, trusting implicitly in the latter's financial ability, which was unfortunately as little as the bishop's own. When the crash, rendered inevitable by faulty business methods, came, Edward died broken-hearted. The indebtedness reached nearly \$4,000,000, and the crisis came at a time of general financial panic. The bishop, however, was never accused of any dishonesty, though the unwisdom of his confidence in his brother was widely criticised. His own light regard for the value of money was well known, as he had served as bishop for 25 years before he accepted even the "cathedraticum" of \$5,000 a year, and when paid it usually was given away before night. He tendered his resignation in 1880, but it was not accepted though he was given a coadjutor. At his death the Roman Catholics in his original diocese numbered half a million. He published a series of text-books for the use of Roman Catholic schools in his diocese.

Purchas, pēr'chas, Samuel, English author and Anglican clergyman: b. Thaxted, Essex, about 1575; d. London September 1626. He was graduated from Cambridge, took holy orders, was vicar of Eastwood, Essex, 1604-13, and in 1614 became rector of Saint Martin's, Ludgate, London, where he remained until his death. He published in 1613 'Purchas his Pilgrimage, or Relations of the World and the Religions Observed in All Ages and Places,' supplemented in 1625 by 'Purchas his Pilgrimmes' in four volumes. The first is his own work and the latter a collection of the narratives of different travelers, edited by him. The latter was illustrated with maps, and the edition of 1626 was supplemented by a fifth volume. It was a work of great value in its day, giving accounts of travels in Europe, Asia, Africa, and America, and was soon imitated. It is valuable to-day as revealing the ideas prevailing in England at that time

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concerning the rest of the world at large. He also wrote: 'Microcosmos, or the History of Man' (1619); 'The King's Tower and Triumphal Arch of London' (1623).

Purdue University, the Indiana State college of agriculture and technology at Lafayette. It was established under the land grant act of 1862; and in 1869 was named for John Purdue who gave \$150,000 and 100 acres of land to the State for the institution. It was first opened to students in 1874. Its present organization includes six schools: (1) the School of Mechanical Engineering; (2) the School of Civil Engineering; (3) the School of Electrical Engineering; (4) the School of Agriculture; (5) the School of Science; (6) the School of Pharmacy. The regular courses extend over four years; in addition the School of Agriculture offers a special two years' course, and a short course of two winter terms; and the School of Pharmacy also offers a two years' course. In 1902 a course in telephonic engineering was added. The degrees conferred are bachelor of science, and graduate in pharmacy. Graduate work is provided for and the degrees of master of science, mechanical engineer, electrical engineer, civil engineer, and analytical chemist are given to graduate students. Instruction in military science and tactics is a part of the curriculum, and all men students are expected to join the military company for two years. The college is coeducational, women entering mostly the schools of Science, of Pharmacy, and of Agriculture. The grounds comprise 180 acres, 50 of which are used as the university campus, the remaining 130 being devoted to the experimental farm for the School of Agriculture. In 1902 a new agricultural building was completed furnished with the best modern apparatus, in 1903 the Eliza Fowler Hall was completed, containing the auditorium and the offices of the president; other buildings of importance are the engineering building for the departments of Mechanical and Civil Engineering, the electrical building, Science Hall, the veterinary infirmary, Purdue Hall, and Art Hall. The laboratories are all well equipped with modern scientific appliances, the equipment of the School of Mechanical Engineering including a locomotive testing plant. The library contains (1910) 30,000 volumes. The agricultural experiment station is also connected with the University, and farmers' institutes are organized throughout the State. Tuition is free for residents of the State; the income is derived mostly from the land grant fund of 1862, from the national appropriation and from the State tax; in 1910 it amounted to \$492,000. In 1910 the students numbered 1,867; the total number of graduates 3,539. Its rank among schools of technology is high, and it holds an influential place in the educational system of the State.

Purgatives, cathartics; medicines for evacuating the bowels. See CATHARTIC; CONSTIPATION.

Purgatory, according to the doctrine of the Roman Catholic Church, a state or place in which the souls of those who depart this life in the grace of God suffer for a time, in expiation of their venial transgressions or in undergoing the penalty due to mortal sins, the guilt and eter-

nal punishment of which have been remitted. Hence purgatory is not a place or state of probation: for the souls in purgatory the time of probation is past, and they are already assured of their everlasting bliss in heaven, though as yet they are not sufficiently pure and holy to be admitted to the vision of God. The dogmatic teaching of the Church goes only so far as to declare that, (1) there is a purgatorium (place of purification), and (2) that the souls therein are aided by the prayers of their brethren on earth. But though the definitive teaching of the Church stops here, the speculations of divines, the meditations of spiritual men, and the beliefs of the general mass of the faithful go much further, and have developed an idea of purgatory which is very much more definite. Thomas Aquinas and Suarez, among the greatest lights of the theological schools, teach that instantly after passing out of the present life, the faithful souls are cleansed from the stains of all venial sin by their turning with perfect love to God; at the same time the debt of the temporal penalties of sin, whether mortal or venial, has still to be paid. It is the common belief of the Western Church that the purgation is by material fire, and the teaching of theologians is that the purgatorial pains are very terrible. While confessedly the doctrine of purgatory is not clearly and unequivocally deducible from any passage of the universally accepted books either of the Hebrew or the Christian Scriptures (for Macabees is not received by all as canonical, and passages of the New Testament which Catholics believe to point decisively to this doctrine have no such signification for Protestants), it is admitted on all sides that in the very earliest church liturgies that are extant are found forms of prayer for the dead, and that the existence of an intermediate state after death is taught by the Fathers both Eastern and Western with practical unanimity, so far at least as to admit that the dead can be aided by the prayers of the living.

Purification, in the Jewish ceremonial law, a bodily cleansing with water accompanied by rites more or less elaborate according to the nature of the uncleanness from which the person was to be purified: this physical cleansing being regarded as emblematical of an inward spiritual purification. For different occasions of purification and different rites, see Leviticus xi. 25-40, xv. 1-15, xv. 18, Numbers xix. Similar rites of purification are common to pagan religions whether of ancient or modern times. In the ritual of the Roman Catholic Church, the rinsing of the chalice after communion and the ablution of the fingers of the celebrant after the same are called a purification.

Purification of the Blessed Virgin Mary, **Feast of the**, a festival observed in the Roman Catholic Church on 2 February: in the calendar of the Episcopal Church in the United States as well as in that of the Established Church of England the Purification of the Virgin Mary is entered for the same day, and in the Book of Common Prayer there are collect and lessons for the day of "the Presentation of Christ in the Temple, commonly called the Purification of Saint Mary the Virgin." The events commemorated by the Church on this day are those recorded in the gospel of St. Luke, ii. 22-39, namely, the go-

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ing of the Virgin to the Temple 40 days after the birth of her son, for her ritual purification after childbirth, according to the prescriptions of Leviticus xii.; the presentation of the babe to the Lord; and the prophecies of Simeon and Anna. The Christian festival of the Purification was solemnized by the Church at least as early as the end of the 6th century. It is customary on this day, in Catholic countries, for the people and clergy to form processions, each one carrying a lighted candle, signifying the light which the Redeemer brought into the world.

Purifying Apparatus (Electrolytic), for purifying liquids, especially water, for industrial, city and town purposes; a recent invention is an improved apparatus and system for the purification of sewerage and water supply. After several years' experimenting with various metals for an electrode to coagulate the impurities in water (organic and inorganic) it has been found that certain metals are capable of producing while under the action of an electric current immersed in the liquid to be purified, in the form of a sheet or plate, an insoluble hydroxid of the chlorides and sulphates held in solution, which are set free by the action of current passing through the liquid (see **ELECTROLYSIS**); hydrogen being evolved at the cathode and oxygen at the anode, which destroys the animal and vegetable life, leaving the water clear, free from odor and disease-breeding germs, sparkling, with a pure water taste (see **DISTILLATION**). For municipal supply, means are provided for the generation of electricity by either hydraulic or artificial power, using large basins for the water to flow through containing the electrodes, which purifies on its passage out of the basin into a coagulating section, being provided with means to retard the suspended matter, allowing the water to flow down an inclined weir for the purpose of aeration, into another compartment of the basin containing screens, which clarifies it free from all sediment, thence to storage reservoirs; occupying small space as compared to sand bed filters and automatic in operation. The apparatus for potable and industrial use consists of vessels capable of working under high pressure as for boiler feed purposes, one of which contains the electrodes or a series of them for very large supply; the electrodes being connected to a suitable source of electric supply, the vessels being provided with air-valves and insulators to prevent the grounding of the current, and connected to other vessels by suitable conduits to remove the suspended matter, thus permitting a constant flow of the water through the apparatus, requiring small space and installed at any convenient point that the water can be conveyed to. A special feature of the device is the means employed to reduce the consumption of the electric current which has been one of the chief sources why heretofore this method of purifying liquids by electrolysis has not been commercial. The theory of using electricity to purify liquids has long been known from a laboratory standpoint, but the methods and electrode used by this company have established the practical and commercial value of this system for the purification of liquids by electrolysis, on a large scale.

WILLIAM R. CHIPMAN,
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pany of New York.*

Purim, *poo'r'im*, the Festival of Lots, which was instituted by Mordecai (Esther ix. 27-x. 3), and is celebrated to this day by the Jews on the 14th and 15th of the month Adar (March), in commemoration of their wonderful deliverance from the destruction with which they were threatened by Haman. On these festive days the book of Esther is read, presents are interchanged, and gifts are sent to the poor. The great popularity of this festival in the days of Christ may be gathered from the following remark of Josephus: "Even now all the Jews that are in the habitable earth keep these days as festivals and send portions to one another." It is supposed that it was this feast which Jesus went up to celebrate at Jerusalem (John v. 1). It is universally celebrated by the large Hebrew population in the United States.

Puritan City, a name applied to Boston, Mass., referring both to the early settlers and the characteristics of its modern inhabitants.

Puritanism. The Puritans were those who thought that the English Reformation had not gone far enough in its separation from the Roman Catholic Church, but that there were many ceremonies and forms still retained in the worship which were too suggestive of Papacy. They held that it was not expedient or right to retain the use of the cross in baptism, the clerical vestments, the custom of kneeling at the altar, and other forms which had been rejected by the Reformed Churches on the Continent. They believed that the worship should in this way be purified and that only those who lived upright lives should be the ministers of the church. To them the church was a means of advancing religious truth, and it could not do this to the best advantage while hampered, as they thought, by useless, misleading and unscriptural forms and ceremonies, especially when these forms and ceremonies were obligatory for all and the observance of them enforced by the civil authority. During the persecution of the Protestants in the reign of Mary, hundreds of the English reformers went to the Continent and were in the company of the leaders of the Reformed Church. When Elizabeth came to the throne, these men returned and became the leaders of English protestantism. Some of them regarded the wearing of the vestments prescribed by the Church authorities as a matter of indifference, others refused to wear them. They did not object to the government of the Church of England or the close connection between Church and State or the doctrinal system, but objected to what they regarded as the remnants of popery.

Whether they would be allowed to do as they wished or not depended largely on the attitude of the queen. Elizabeth was a woman whose religious tastes were stronger than her religious convictions and the simplicity and bareness of the worship of the Reformed Church offended her. She disliked Puritanism because the teachings of men like John Knox opposed her idea of the royal power. She opposed any puritanical modifications of the Prayer Book or of the ceremonies of the church. That there was to be no room for nonconformity was shown when her first parliament passed the Act of Uniformity, which made unlawful any form of public worship but that of the Prayer Book, and the

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Act of Supremacy, by which the queen was acknowledged supreme governor of the realm in spiritual and ecclesiastical affairs. She resolved to retain in the worship as much show and form as possible, and ordered uniformity in vestments. If any refused they were forbidden to preach and deprived of their office. This law was not strictly enforced at first, but with greater rigor as the time went on. Large numbers were ejected from their churches, but continued to hold private meetings. Many were imprisoned and treated with severity. But nonconformity continued to grow notwithstanding the efforts to suppress it.

In early Puritanism the objection is mainly to the forms and ceremonies in the worship of the church. In the later years of the reign of Elizabeth, attention is given to the government of the Church and the relation between Church and State. Elizabeth claimed that in this her will was supreme. Some of the Puritans, above all others, Thomas Cartwright, taught that the only right form of Church government was that laid down in the New Testament and that it was Presbyterianism. He taught that the civil authorities are not to interfere in Church affairs, but they are bound to protect it. There is still to be a state church but with a Presbyterian rather than an Episcopal form of government. This was directly opposed to the Queen's supremacy, and her efforts to suppress this form of Puritanism were vigorous. These Puritan movements were within the Established Church, but there were some who believed that a church having any connection with the state was unscriptural and so there arose the party called Independents or Separatists. They taught that the local church was independent and should manage its own affairs. These were also called Brownists from Robert Browne, who was their first leader. The Separatists were severely persecuted and many left the country. Thus, at the close of the reign of Elizabeth, there are three kinds of Puritans: those who desire a purified worship and still remain in the Church, those who would have a state church under the Presbyterian form of government, and those who believed that an established church was wrong. Hopes were entertained that James VI., educated in Presbyterian Scotland, would be more favorable to Puritanism. The clergy petitioned him for freedom from the burden of human rites and ceremonies and the matter was considered at the Hampton Court Conference. But James' motto was "No bishop, no king," so they could look for little toleration. Uniformity was enforced with great vigor and many Puritans deprived of all hopes of redress left the country. This condition continued with even greater severity in the reign of his son, Charles I., and there seemed in the early part of his reign no check on his tyranny in church and state. Despairing of freedom in Old England, Puritan and Separatist turned to America to create there a New England. In 1620 a little company of Separatists after a sojourn in Holland came to America and settled at Plymouth. In the course of the next 20 years thousands of Puritans settle in Massachusetts. This Puritan emigration stops in 1640, when there seems a better prospect of liberty in England. The Puritan emigrants came as members of the Church of England with no desire to separate. The Pilgrims were already

separated from the English communion and were independent in their church government. But the Puritans because of their distance from the home country and because of the influence of the Pilgrims very quickly adopted the Congregational or Independent form of church government.

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Pu'ritans. See PURITANISM.

Pur'kinge's Figures, in optics, figures produced on a wall of uniform color when a person entering a dark room with a candle moves it up and down approximately on a level with the eyes. From the eye near the candle an image of the retinal vessels will appear projected on the wall.

Purple of Cassius, a purple substance used to some extent in the arts, discovered by Dr. Cassius at Leyden in 1683. This substance is probably an oxide of gold containing small quantities of oxide of tin; it is prepared by adding protochloride of tin, along with a little perchloride, to a solution of chloride of gold, when it is thrown down in the form of a dark purple-colored precipitate. Purple of Cassius, mixed with borax and applied to the surface of china, imparts a beautiful rose-pink or rich purple color, according to the quantity employed.

Purple Color. The ancients attributed the discovery of purple to the Phœnicians. The story of its having been discovered by a dog biting a purple-fish, and thus staining his mouth, is well known. The purple-fish was found not only on the Phœnigian coasts, but in all other parts of the Mediterranean, so that the use of it in dyeing came to be common with other nations. The modern discovery of purple colors from coal-tar makes an important epoch in the history of the dye. Painters in oil and water-colors produce various shades of purple by mixing certain red and blue pigments. For work in oil French ultramarine, often called French blue, is mixed with vermilion or some madder red (madder carmine is best), or one of these reds with cobalt blue if a pale purple is wanted. For permanent purples in water-colors the same blues are used; but one of the madder reds, not vermilion, should be mixed with them. A much richer purple than any of the above mixtures will give is produced by Prussian blue and one of the lakes from cochineal—namely, carmine or crimson lake—but it is not permanent. This purple, as well as that obtained by mixing Indian red with indigo, also fugitive, was much used by water-color painters in past years. Purple madder is the only simple purple pigment available for the artist which is durable, and it is unfortunately costly. All purples are changed to neutral and gray tints by the addition of any yellow pigment. For house-painting maroon lake with a little French blue gives a useful purple. See DYES.

Purple-faced Monkey. See LANGUR; WAN-DEERO.

Purple Falcon, Order of the. See ORDERS, ROYAL.

PURPLE FINCH — PURUS

Purple Finch, a handsome American finch (*Carpodacus purpureus*) which in some one of its varieties is known throughout the United States and Canada. The male exhibits in spring a plumage beautifully tinged with rose red and crimson; and sings a brilliant melody. These birds nest in orchard trees and similar places, and lay greenish speckled eggs.

Purple Martin, one of the large, lustrous, blue-black swallows of the genus *Progne*, several species of which inhabit South and Central America, while one (*P. subis*) is a familiar visitor in summer to almost all parts of the United States. They originally nested in hollow trees, but in both North and South America have at once associated themselves with mankind as soon as civilization approached their habitat; and now everywhere make their nests about buildings or in garden bird-boxes. They are among the most useful as well as interesting of our insect-hunting birds.

Purple Scale. See SCALE INSECTS.

Purple Shell, a gastropod mollusk of the family *Muricidae* and especially of one section of it of which the genus *Purpura* is typical. A great many species are found in all seas. The true purples form the subfamily *Purpurinae*. The *Muricidae* are carnivorous marine snails very destructive to other mollusks, barnacles, etc. Many of the tropical species of *Murex* and related genera are of large size and remarkable for the large spines borne upon the shells, but our representatives of the family are small and inconspicuous. (See DRILL.) Our true purple shell (*Purpura lapillus*) is found in great abundance on rocky coasts on both sides of the North Atlantic, but is infrequent in the United States south of Long Island Sound, where it is replaced to some extent by related species. The shell is very thick and solid, short oval with a low spire and a large aperture, the outer lip of which is marked with revolving ridges. It is extremely variable in size, shape, color, and markings. Like the drill it is carnivorous, but with us confines its attacks chiefly to the barnacles which encrust the rocks between tides, though in Europe it works great havoc on the mussel beds.

The name "purple shell" applied to this group of mollusks is derived from the use to which certain species were put by the ancients in the preparation of their most valued dye-stuffs, for which the city of Tyre was especially famous, and upon which its prosperity about 1000 B.C. was founded. The Tyrian purples were of several shades, varying from blue to a dull crimson, dependent upon the particular variety of shell employed and the substances mixed with the extract. Among the most important species utilized were *Murex trunculus*, *M. brandaris*, and *Purpurea patula*. These snails were gathered on both the African and European shores of the Mediterranean. The smaller ones were crushed in mortar-shaped holes in the rocks and mixed with soda, urine, sea-water, and other substances; the larger animals were removed from their shells or the dye squeezed out. The desired colors were obtained by exposure to the sun and by various combinations, and the cloth was steeped in a large excess of fluid until the proper effect had been produced. The fluid is contained in a saccular gland which opens into

the mantle cavity and has at first the color and consistency of cream and a disagreeable odor, but changes to purple upon exposure to light. Consult Simmonds, 'Commercial Products of the Sea.'

Pur'pura. See PURPLE-SHELL.

Purse, a specific sum of money, usually awarded as a prize in athletics, horse-racing, and other sports. In Turkey it consists of 500 Turkish piastres, and its value is \$22; in Egypt a purse consists of 500 tariff piastres, value \$25; in Persia, 50 tomans, value \$107. See PRIZE.

Purser, a name applied to the cashier or chief clerk on board a passenger steamer. In the navy a purser was formerly an officer who took charge of the provisions of a ship of war, and saw to their distribution among the officers and crew. He had very little to do with money matters, but generally bore an evil reputation among the sailors for unfair dealing and rapacity. The designation is now discarded for that of paymaster, who holds a different position.

Purs'lane, a pot-herb and well-known weed forming good fodder for pigs and called "pussley" by farm-hands. See PORTULACA.

Pursuivant, pēr'swī-vant, a title used in the heraldry of England, Scotland, and Ireland, and derived from the Latin word "prosequi" to follow. It is the lowest of heraldic offices, but from the pursuivants were usually selected the superior officials known as herald and king-at-arms. The English college of arms has four pursuivants, the Scottish heraldic establishment has three, and the Ulster king-at-arms in Ireland has four.

Puru-Purus, poo-roo'-poo-roos', or **Puru Pulas**, a tribe of Brazilian Indians, now extinct or represented only by the Pamary or Pamarary, but formerly living along the Purus River (q.v.) in western Brazil. They were naked savages, who slept on the sand instead of in hammocks, and were afflicted by a leprous disease which covered them with bluish and whitish spots. They used practically no sheltering or covering, except leaf umbrellas, and wore their hair long and unkempt, cut only on the forehead in a square bang. Linguistically they seem to have been separate from the surrounding peoples.

Puruandiro, poo-roo-ân-dē'rō, Mexico, a town of the state of Michoacán and capital city of the district of Puruandiro in central Mexico, situated on the southern shore of a small lake, about 42 miles northwest of Morelia. It does a small business in Mexican leather and in the agricultural produce of the surrounding country.

Purus, poo-roos', a South American river, an affluent of the Amazon, rising in the east of Peru traversing the northwest corner of Bolivia, entering Brazil, and after a northeastward course of over 1,800 miles, joining the Amazon about 100 miles above the latter's confluence with the Madeira. It has a very winding course and a comparatively slight fall. In the flood season it is navigable almost throughout its length. Chief among its numerous tributaries is the Acre. Its source was discovered in 1864 by Chandless, an English explorer.

PURVER — PUSEY

Purver, pèr'vèr, **Anthony**, English translator: b. Hurstbourne, Hampshire, 1702; d. Andover, Hampshire, July 1777. He was at first apprenticed to a shoemaker, but mastered Hebrew, and at 20 opened a school. Later he went to London where he became a Quaker and there began his translation of the Bible in 1733, a task which occupied him for 20 years. It was completed in 1763 and published under the title 'A New and Literal Translation of all the Books of the Old and New Testament' (1764). The publication was known as the 'Quaker's Bible' and by many was pronounced crude and unscholarly, while warmly approved by Southey and other critics. He also published: 'Youth's Delight' (1727); 'Poem to the Praise of God' (1748); and 'Counsel to the Friend's Children' (1785).

Purves, pèr'vès, **George Tybout**, American clergyman: b. Philadelphia, Pa., 27 Sept. 1852; d. New York 24 Sept. 1901. He was graduated from the University of Pennsylvania in 1872 and from the Princeton Theological Seminary in 1876. He was pastor at Wayne, Pa., 1877-80; and professor of New Testament literature and exegesis at Princeton Theological Seminary 1892-1900. In the last named year he accepted a call to the 5th Avenue Presbyterian Church, New York. He wrote: 'The Testimony of Justin Martyr to Early Christianity'; 'The Apostolic Age'; etc.

Purvey, pèr'vi, **John**, English Biblical translator: b. Lathbury, Buckinghamshire, about 1354; d. about 1427. While associated with Wyclif, whose disciple he became, he undertook with other scholars the revision of the translation of the Bible made by Wyclif in 1380. The revision was substantially a new work merely based on Wyclif's copy which had retained many Latinisms from the Vulgate. The new translation, on the other hand, was made in good idiomatic English. It was completed about 1388, four years after Wyclif's death. For his Wyclifite views he was imprisoned in 1390, recanted to escape martyrdom in 1401, and for two years was vicar of West Hythe, Kent. Purvey wrote against the corruption of the Church, a work entitled 'Ecclesie Regimen.' Consult: Lechler, 'John Wiclif and his English Precursors,' translated by Lorimer (1884).

Pus. See SUPPURATION.

Pusey, pū'zī, **Caleb**, American Quaker colonist: b. Berkshire, England, about 1650; d. Chester County, Pa., 25 Feb. 1727. He was educated a Baptist, but joined the Quakers and came with Penn's company to America in 1682, erected the first mills in the province known as the 'Chester Mills,' and of which Penn himself laid the cornerstone. He laid out roads, treated with the Indians, was sheriff of Chester County for two years, justice of the peace and of the county courts for many years, an associate justice of the supreme court, and for 10 years member of assembly. He published a great number of pamphlets and articles in defense of his creed, among them: 'A Serious and Seasonable Warning' (1675); 'A Modest Account from Pennsylvania of the Principal Differences in Point of Doctrine between George Keith and those of the People called Quakers' (1696); 'Satan's Harbingers Encountered' (1700); etc.

Pusey, Edward Bouverie, English scholar and theologian: b. near Oxford 22 Aug. 1800; d. Ascot Priory, Berkshire, 16 Sept. 1882. He was a son of the Hon. Philip Bouverie (of the Radnor family), who assumed the name of Pusey by royal license on becoming lord of the manor of that name in Berkshire. He was educated at Eton and Oxford University, where he was graduated with first class honors. Soon after he was elected to a fellowship at Oriel College. He studied for two years in Germany, taking up more especially Oriental languages, theology, and German, and in 1828 was appointed regius professor of Hebrew, a post which he retained all his life, and to which a canonry at Christ Church is attached. In 1826 he had published a book summarizing the progress of German theological thought since the Reformation, expounding the rationalistic views regarding religion which were common in Germany, his account of which was founded on his own personal experience of what he believed to be the evils of Rationalism. He became through the influence of his friends Hurrell, Froude, and Newman an ally of the theological party who started the Tracts for the Times (see TRACTARIANISM), but the agitation had been going on a little time before he took an active part in it. His first tract was the 18th, 'On the Benefit of Fasting'; he subsequently wrote another (the 66th) on the same subject, and two (the 67th, and 69th) 'On Holy Baptism.' In connection with the same High Church movement he undertook the joint-editorship of the 'Library of the Fathers' and the 'Library of Anglo-Catholic Theology.' In 1843 he was suspended from preaching in the university pulpit for three years on account of a sermon on the Eucharist, in which he advocated the doctrines of the real presence, sacerdotal absolution, and of the duty and privilege of confession. Except for literary labors and occasional sermons, Dr. Pusey's life was henceforward an uneventful one. Among his chief works are a treatise on 'The Ancient Doctrine of the Real Presence'; 'Letters to the Archbishop of Canterbury in Defence of Church Principles'; a treatise on 'Marriage with a Deceased Wife's Sister'; a 'History of the Councils of the Church' (1857); a learned 'Commentary on the Minor Prophets' (1860-77), an important contribution to Hebrew scholarship. Nine lectures on 'Daniel the Prophet' (1864), and 'The Church of England, or Portion of Christ's Holy Catholic Church: an Eirenicon' (1865). As a leader of the Tractarian or High Church party he kept a large section of that party from drifting into the Catholic Church and remained unshaken in his fidelity to the church of his baptism, while Oakley, Ward, Wingfield, Newman, and more than 100 other English clergymen went over to Rome. On this ground, perhaps, the party received the popular name of Puseyites. Pusey was one of the few Oxford professors whose linguistic accomplishment laid open to him the latest researches and discoveries of German scholarship. He was very retired in his habits, but kind-hearted, and his charity was unbounded. Pusey House, one of the most recent of Oxford colleges, was founded as a memorial to him, and was intended to continue the tradition of his teaching which it has done to the same extent as All Souls has fulfilled the purpose of offer-

PUSEYISM — PUTNAM

ing masses for the repose of the souls of those who perished in the Hundred Years' war. Consult: Liddon, 'Life of Edward Bouverie Pusey' (1893-7); Grafton, 'Pusey and the Church Revival' (1902).

Puseyism. See OXFORD MOVEMENT, THE.

Pushkin, poosh'kin, **Alexander** (spelled also **POUSHKIN**, **POUCHAKIN**), Russian poet; b. Moscow 26 May (7 June) 1799; d. Saint Petersburg 29 Jan. (10 Feb.) 1837. He received his first education in the Lyceum at Tsarskoë-Selo. In 1817 he entered the service of the government in the ministry of foreign affairs, in 1820 was retired to southern Russia because of his liberal opinions, until 1824 was a subordinate in the office of the governor-general of Odessa, angered his superior by an epigram, and was withdrawn wholly from the service and ordered to live on his estate of Mikhailovskoë. In 1826 Nicholas I. allowed his return to Saint Petersburg, where he was made imperial historiographer. His only work of research, however, was the 'History of the Revolt of Pugachev'; he labored in the archives on an account of Peter the Great, which came to nothing. He died from a wound received in a duel, and the Czar appropriated 150,000 rubles to settle his affairs and publish his works. These included, above all, 'Evgenie Onyegin' (1828), a metrical narrative in a somewhat Byronic fashion; and 'Boris Godunov,' a tragedy dealing with the troublous period following the death of Czar Feodor. Pushkin performed a great service for the Russian language and literature; molding the former, which, prior to his time was uncouth and unwieldy, and freeing the latter from its French tradition and placing it solidly upon a native basis. He has been called "undeniably and essentially the great national poet of Russia." There are English renderings of 'Evgenie Onyegin' (by Spalding, 1881); of the 'Poems' (by Panin, 2d ed. 1888); and of the 'Prose Tales' (by Keane, 1896). A memorial work, 'Translations from Pushkin,' by Turner, appeared in 1899. Consult: Shaw, 'Sketch of Pushkin's Life and Works' (1845); Flach, 'Un Grand Poète Russe' (1894).

Puss in Boots, a well-known nursery tale by Charles Perrault, whose version, 'Le chat botté' appeared in his 'Contes de Fées' (1697). It was probably taken from Straparola's 'Piacevoli Notti.' The story is found in a Norse version in 'Lord Peter,' and in the Swedish 'Palace with Pillars of Gold,' in which the cat befriends a girl, whose adventures are similar to those of the Marquis of Carabas. In a Sicilian version is found the first hint of a moral which is lacking in the above-mentioned tales; that is, the ingratitude of the man. Cosquin imagined from the moral that its origin was Buddhist, for the story could only have arisen in a comparatively civilized community; but the only Hindu version, the 'Match-Making Jackal,' discovered about 1884 in Bengal, has no moral at all. The most complete moral is found in Zanzibar, in the Swahili tale of 'Sultan Darai,' in which the beneficent beast is a gazelle: the ingratitude of the man is punished by the loss of all that he had gained; the gazelle, which dies of neglect, is honored by a public funeral. A well-known German version is that by Tieck, 'Der gestiefelt Kater' (1795).

Pus'tules. See PIMPLES.

Put Yourself in His Place, a novel by Charles Reade, published in 1870. The scene is laid in an English manufacturing town, and the story narrates the struggles of Henry Little, workman and inventor, against the jealousy and prejudice of the trades-unions. Like all of Reade's stories, 'Put Yourself in His Place' has a wealth of dramatic incident, and moves with dash and vigor.

Putchcock, pū-chōk', or **Puchuck**, the root of *Aplotaxis lappa*, the "costus" of the ancients, a composite plant growing on the Himalayas in the vicinity of Cashmere. It has long lyrate leaves and heads of purple florets. It is exported to the Malay countries and to China, where it forms a main ingredient in the Chinese pastille-rods known as joss-sticks. In Upper India it is given as a medicine in various complaints ranging from coughs to cholera, and is also employed in several other ways.

Putlitz, poot'lits, **Gustav Heinrich Gans**, **EDLER HERR VON UND ZU**, German novelist and poet; b. Retzin, Prussia, 20 March 1821; d. there 9 Sept. 1890. He was educated at Magdeburg, Berlin, and Heidelberg, was engaged in the civil service in 1846-8 and made his début in literary circles by his comedies which aptly portrayed high social life and excelled in humor. In 1863 he was appointed director of the court theatre at Schwerin, and his collected dramas were published in 1850-69. His poems were characterized by much beauty and grace and his charming fairy poem 'Was sich der Wald erzählt' (1850) was widely circulated. His novels were also popular. Among his publications are: 'Vergissmeinnicht' (1851); 'Brandenburger Geschichten' (1862); 'Novellen' (1863); 'Funken unter der Asche' (1871).

Putnam, pūt'nam, **Frederick Ward**, American archaeologist and ethnologist; b. Salem, Mass., 16 April 1839. He became curator at Essex Institute in Salem in 1856, was graduated from Harvard in 1862, and in 1864 became director of the Essex Institute museum. In 1867 he was appointed superintendent of the East Indian Marine Society's museum at Salem and in 1875 was appointed civilian assistant on the United States surveys west of the 100th meridian, his duties being to make investigations and reports of the archaeological and ethnological material collected. In 1876-8 he was in charge of the Agassiz collection of fishes at the Museum of Comparative Zoology and in 1886 was appointed professor of American archaeology and ethnology at Harvard. He was chief of the department of ethnology at the World's Columbian Exposition in 1893. He is author of numerous pamphlets on scientific subjects, was one of the founders and editors of the 'American Naturalist,' and has edited many volumes of 'Annual Reports of the Trustees of the Peabody Museum of Archaeology and Ethnology' and 'Proceedings of the Essex Institute.'

Putnam, **George Haven**, American publisher and author, son of G. P. Putnam (q.v.): b. London, England, 2 April 1844. He was educated in New York, Paris, and Göttingen, leaving the university at the latter place to enter the Union army as a volunteer in 1862. He served through the war, was a prisoner at Libby in the winter of 1864-5, and attained rank as major of volunteers. He is head of the firm

PUTNAM

G. P. Putnam's Sons, was a leader in reorganizing the American Copyright League in 1887, and was instrumental in securing the passage of the copyright bill in 1891. He has published: 'Authors and Publishers' (1883); 'The Artificial Mother' (1894); 'Books and their Makers in the Middle Ages' (1896); etc.

Putnam, George Palmer, American publisher and author: b. Brunswick, Maine, 7 Feb. 1814; d. New York 20 Dec. 1872. He entered the book store of Jonathan Leavitt in New York in 1828, became a member in the firm Wiley and Putnam in 1840 and in 1841 went to London where he conducted a branch business. In 1848 he returned to New York, opened a publishing house, engaged in the production of finely illustrated books and established 'Putnam's Magazine' 1853-6, which was resumed in 1868 and afterward merged with 'Scribner's Monthly.' In 1866 he established the publishing firm now known as G. P. Putnam's Sons. He was an ardent advocate of international copyright reform, secretary for many years of the Publishers' Association, a founder of the Metropolitan Museum of Art, and wrote: 'A Plea for International Copyright' (1837); 'Chronology' (1833); 'The Tourist in Europe' (1838); 'American Facts' (1845); 'The World's Progress' (1850); 'Ten Years of the World's Progress' (1861); etc.

Putnam, Herbert, American librarian: b. New York 20 Sept. 1861. He was graduated from Harvard in 1883, studied law at Columbia and in 1886 was admitted to the bar. He was librarian at the Minneapolis Athenæum in 1884-7 and of the Minneapolis Public Library 1887-91; practised law in Boston in 1892-5, was librarian of the Boston Public Library in 1895-9 and in the latter year was appointed librarian of Congress. He became president of the American Library Association in 1898 and one of the overseers of Harvard in 1902.

Putnam, Israel, American Revolutionary soldier: b. Salem (now Danvers), Mass., 7 Jan. 1718; d. Pomfret (now Brooklyn), Conn., 19 May 1790. His education was a desultory one. In 1740 he removed from Salem, and purchased in that part of Pomfret, Conn., which is now Brooklyn, the farm where he afterward resided. It is said that he also hung out a shingle advertising entertainment for man and beast. There is also the well-known anecdote of the exploit in which he crept into the lair of a destructive wolf, and there despatched the animal. But little definite is known of Putnam's life until he is found in 1755 in receipt of a commission as captain of Connecticut volunteers in a regiment sent by the colony to aid in repelling a threatened French invasion of New York. He was present at the defeat of the French and Indians under Dieskau near the southern end of Lake George, and later was very successfully employed as a ranger and scout. In 1756 he commanded a company in Abercrombie's army, which had Crown Point as an objective, but was so outplayed by Montcalm as to be obliged to act rather defensively than offensively. He received a major's commission from the Connecticut legislature in 1757. During Abercrombie's expedition against Ticonderoga in 1758, Putnam commanded an advance guard and scouting party of 100. In the retreat following the rash and disastrous attack on the post, he became aide to

Abercrombie, replacing Howe, who had been shot. Having been sent out in August to recapture from the enemy a large quantity of British stores, he was taken prisoner and tortured by the Indians, but rescued by a French officer. He was sent to Ticonderoga and thence to Montreal, where he was exchanged. Promoted lieutenant-colonel in 1759, he accompanied the force sent against Montreal, upon whose surrender Canada passed into English hands. In 1762 he commanded the contingent of 1,000 sent by Connecticut in the naval expedition against Havana. His vessel was wrecked off the Cuban coast, but those on board escaped by rafts, and took part in the successful attack on Havana. He was sent out against the Indians of the frontier, who, under Pontiac (q.v.), were menacing Detroit, in 1763. A peace was concluded; Putnam returned to his farm, and there remained in retirement until 1775. When the news of Lexington reached him, he is said to have been plowing, Cincinnatus-like; and at once to have turned loose the oxen and ridden to Cambridge. A Connecticut regiment was forthwith organized, and Putnam, with a brigadier's commission, appointed to command it. In May he led a battalion to Noddle's Island, where he captured a sloop and burned a schooner of the enemy. He was a participant in the battle at Breed's (Bunker) Hill, which he had helped to fortify; the chief command in the action has been claimed for him against Prescott. Trumbull, in his picture in the Capitol at Washington, shows Putnam in brilliant uniform defending a gun. Commissioned major-general in July, he was placed in command at New York, and was ranking officer within the fortifications during the battle of Long Island. After having been stationed at Philadelphia, Crosswick, and Princeton, he was sent in May 1777 to command in the "Highlands" of New York. Owing to the loss of Fort Montgomery and Fort Clinton, he was removed from his command; but later was restored on being acquitted by a court of inquiry. Subsequently, when he was commanding in Connecticut, Horseneck, an American outpost, was attacked by the British under Tryon. Putnam, according to the story, escaped by dashing on horseback down-hill, and eventually pursued the retreating Tryon, from whom he took 50 prisoners. In the winter of 1779 he was stricken with paralysis and incapacitated from further service. Consult 'Lives,' by Tarbox (1876) and Livingston (1901).

Putnam, John Pickering, American architect: b. Boston, Mass., 1847. He was graduated from Harvard in 1868, studied later in the Ecole des Beaux Arts, Paris, and in the Royal Academy of Architecture, Berlin. He has since practised his profession in Boston and has published: 'The Open Fire Place in All Ages'; 'The Principles of House Drainage'; 'Improved Plumbing Appliances'; 'The Outlook for the Artisan and His Art.'

Putnam, Mary Traill Spence Lowell, American author, sister of James Russell Lowell (q.v.): b. Boston, Mass., 3 Dec. 1810; d. there 1 June 1898. She was married to Samuel R. Putnam in 1832, and later traveled abroad for several years. Her literary work was confined to magazine writing until 1844, when she translated from the Swedish Fredrika Bremer's 'The Handmaid.' She afterward published: 'His-

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tory of the Constitution of Hungary' (1850); 'Records of an Obscure Man' (1861); 'The Tragedy of Errors' and 'The Tragedy of Success,' a dramatic poem in two parts (1862); 'Fifteen Days' (1866); 'Memoir of Charles Lowell' (1885); etc.

Putnam, Rufus, American Revolutionary soldier: b. Sutton, Mass., 9 April 1738; d. Marietta, Ohio, 1 May 1824. He was apprenticed in 1754 to a millwright, but acquired some knowledge of surveying and later found employment in that profession. In March 1757 he enlisted as a private for service in the French and Indian war; and re-enlisted yearly until 1761, being made ensign in 1760. His story of the campaigns in which he served may be read in the 'Journal' which he kept throughout. He was a farmer successively at New Braintree, Mass. (1761), Brookfield, Mass. (1765), and Rutland, Mass. (1780). In 1773 he went to Florida as one of an investigating committee appointed to examine lands granted by the crown to colonial soldiers and officers who had fought in provincial regiments during the French and Indian war. Putnam was made deputy-surveyor of Florida by the governor of the province, and accompanied the expedition up the Mississippi to the Yazoo, up the Yazoo to Haines' Bluff, back to the Big Black, and thence in return down the Mississippi. He planned and directed the construction of the Continental lines of defense at Roxbury, and for the excellence of his work was detailed by Washington as acting chief-engineer of the army. On 11 Aug. 1776 he was appointed by Congress chief engineer of the army, with colonel's rank; but preferring service in the field, he resigned in December and took command of the 5th Massachusetts regiment. With the northern army in 1777 he did conspicuous service, particularly at Stillwater, where he headed the 4th and 5th regiments of Nixon's brigade. On 7 Jan. 1783 he was promoted brigadier-general. He was for several years a member of the Massachusetts legislature, and during Shays' rebellion (q.v.) (1786-7) was a very efficient aide on the staff of Gen. Benjamin Lincoln. In March 1787 he was chosen (with Gen. S. H. Parsons and Rev. Manasseh Cutler) a director of the Ohio company, organized (1 March 1786) with a capital of \$1,000,000 in public securities, to be expended in the purchase of land in the Northwest Territory. In July a contract was made with Congress for one and a half million of acres, and soon afterward an ordinance, familiarly known as the "Ordinance of 1787," was passed providing for the government of the territory. On 7 April 1788 Putnam, meanwhile made superintendent of the company, landed with a party of emigrants at the mouth of the Muskingum, and on the present site of Marietta commenced the first organized settlement in the Northwest Territory. He concluded in 1792 at Vincennes a treaty with eight tribes of the Wabash Indians, and in 1793 resigned his commission in the army. He was one of the judges of the United States court in the Territory, 1790-6, and from 1796 until his removal by Jefferson for political reasons in 1803 was surveyor-general of the United States. He was the founder of the first Bible society west of the Alleghanies (1812), a sturdy Federalist in politics, and with the exception of Lafayette the last survivor of the

general officers of the Continental army. Consult his 'Journal,' edited, with sketch, by Dawes (1886). Putnam's papers, including the manuscript 'Journal' and correspondence with Fisher Ames, Trumbull, Washington, and others are preserved at Marietta in the library of the college there; they were edited by Rowena Buell (1904) under the title 'The Memoirs of Rufus Putnam and Certain Official Papers and Correspondence.'

Putnam, Sarah A. Brock, American writer: b. Madison Court House, Va., about 1845. In 1883 she was married to the Rev. Richard Putnam, an Episcopal clergyman. She has published: 'Richmond during the War' (1867); 'The Southern Amaranth' (1869); 'Kenneth, My King' (1872); 'Myra,' a novel.

Putnam, William Le Baron, American jurist: b. Bath, Maine, 12 May 1835. He was graduated from Bowdoin College in 1855, admitted to the bar in 1858 and engaged in law practice in Portland, Maine, 1858-92. In 1887 he accepted an appointment by President Cleveland as commissioner to settle with Great Britain the rights of American fishermen in Canadian waters, and was also a member of the commission under the treaty of 6 Feb. 1896 between Great Britain and the United States. He had twice declined appointments as justice of the Maine supreme judicial court, but in 1892 accepted an appointment as judge of the United States Circuit Court. In 1888 he was the Democratic candidate for the governorship of his State.

Putnam, Conn., city, one of the county-seats of Windham County; on the Quinebaug River, and on the Norwich & W. and the New York, N. H. & H. R.R.'s; about 45 miles east by north of Hartford. It was incorporated from portions of the towns of Thompson, Killingly, and Pomfret, by the State Assembly in May 1855, and was organized as a municipality 3 July 1855 and in 1895 was chartered as a city. Nearby are Cargill Falls, noted for their beauty. It is in an agricultural region, but it has a number of manufacturing interests. The chief industrial establishments are cotton and woolen mills, boot and shoe factories, silk mills, and manufactories of heaters and castings. The number of employees in the manufactories is about 1,900. It has the Day Kimball Hospital, Saint Mary's Convent, and seven churches. The educational institutions are Notre Dame Academy, a high school, public and parish schools, and a public library. There are two banks, one National, with a capital of \$150,000, and one savings, and the business annually is over \$20,000,000. The government is administrated under the charter of 1895 which provides for a mayor, who holds office two years, and a council of nine members. Pop. (1910) 7,280.

Putnam, Fort, a former Revolutionary fort at West Point, N. Y.

Puts and Calls. See STOCK EXCHANGE.

Puttenham, püt'en-am, George, English author: b. about 1530; d. about 1600. He is reputed to be the writer of a work entitled 'The Arte of English Poesie, contrived into three bookes; the first of Poets and Poesie, the second of Proportion, the third of Ornament,' which appeared anonymously in 1589. The Arte is a review of ancient as well as modern poetry, and was written for the court. It shows consid-

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erable literary knowledge and no small critical power. Its author wrote several other pieces which have been lost. The authorship of 'The Arte' has also been claimed for Richard Puttenham, his brother.

Puttiala, püt-të-ä'lä. See **PATIALA**.

Puttkamer, poot'kâ-mër, **Robert Viktor von**, Prussian statesman: b. Frankfort-on-the-Oder 1828; d. Karzin, Prussia, 15 March 1900. He was educated at Heidelberg, Geneva, and Berlin, entered government service in 1854, and as a friend and relative of Bismarck his rise was rapid. He was elected to the Reichstag in 1873 as a Conservative member and in 1877 was chief president of the province of Silesia. In 1879 he became minister of education and public worship and endeavored to carry out the compact Bismarck had made with the Clericals. In 1881 he was appointed minister of the interior and vice-president of the ministry. He energetically enforced measures against the Socialist party and his methods in favoring the election of government candidates aroused the opposition of the Radicals and were bitterly attacked in a speech by Eugen Richter. After the accession of Friedrich III., Puttkamer resigned, and though it was expected that he would be reinstated when Wilhelm II. came to the throne, he was merely appointed chief president of Pomerania in 1891.

Put'tun. See **PATTAN**.

Putty, a substance compounded of whiting and linseed-oil, beaten together to the consistence of a thick dough. It is used by glaziers for the purpose of fixing sheets of glass in the frames of windows, etc., and also by painters for filling up holes in the surface they are about to paint. It becomes very hard when dried.

Putumayo, poo-too-mä'yô, or **Iça**, a South American river, rising in the southwestern part of Colombia on the eastern slope of the Cordillera. It flows southeast for about 1,000 miles, almost on the line of the equator in its mid-course, receives at the right the San Miguel and the Yahuas, and at San Antonio after about 150 miles in Brazil empties into the Amazon. It was explored by Reyes and Crevaux, is navigable within 100 miles of its source, and promises to be a valuable commercial waterway between Brazil and Colombia.

Puvis de Chavannes, Pierre, pë-är pü-vës dë shä-vän, French painter: b. Lyons 14 Dec. 1824; d. Paris 25 Oct. 1898. He sprung from an old Burgundian family of strong Catholic traditions. His father was an engineer and he himself was destined to the same career, but an intervening illness and a journey to Italy confirmed a predilection for painting. His first master was Ary Scheffer, with whom he studied but a short time, and went for a second visit to Italy. Returning he put himself under the tuition first of Delacroix, then of Couture, but parted from each of them after a short period, as he had with his former master, from an inability to submit to any leading but his own artistic instincts. Certain marks of the influence of these men are seen by critics, particularly of Delacroix, even in the very latest products of Puvis' life. These may be traced in the more fundamental traits of his drawing, in the composition, spacing and the like. Others incline

to the belief that his work rather suggests the influence of his early visits to Italy, in a sort of reminiscence of the frescoes of Piero della Francesca. Such suggestions seem for the most part only an effort toward discovering subtle resemblances urged on by the really insistent originality of this artist's work. Working out his own theories which were at variance with all the ruling traditions of his day it is not wonderful that he should have encountered opposition. The Salon refused his work nine times. In 1861 came his first recognition when he gained a second-class medal and sold his pictures 'War' and 'Peace' to the state. These were placed in the Museum of Amiens to which the painter later presented the companion pieces 'Rest' and 'Labor.'

In 1872, as member of the Salon jury, he disagreed with his colleagues and resigned. He was made president of the Society of French Artists, holding their exhibition in the Champs de Mars, and in 1877 was made officer of the Legion of Honor.

As a wall-painter he was the great leader of modern times in recognizing the limitations imposed by this branch of painting and in submitting himself to its demands. He saw that fresco was only the agreeable decoration of a wall surface, which should not attempt to conceal its character as a wall by sharp contrasts of light and shadow and elaborate arrangements of foreshortening and perspective. Consequently he painted in flat tones of cool green, blue, brown or lilac, having always in mind the relation of his designs to their architectural surroundings. His pictures themselves were essentially architectural in their arrangements. Among his mural decorations are those at Marseilles, Lyons, Lille and Poitiers, those in the Hotels de Ville at Rouen and Paris, the Hemicycle of the Sorbonne, in Paris, the series on St. Genevieve in the Pantheon, and the decorations of the staircase of the Public Library in Boston. In the last named work he sought, as he himself stated, "to represent under a symbolic form and in a single view the intellectual treasures collected in this beautiful building. The whole seems to be summed up in the composition entitled 'The Muses of Inspiration hail the Spirit, the Harbinger of Light.' Apollo occupies the centre of this panel and the white-robed Muses, draped in filmy white, are ranged in mid-air against a background of pale green grass, with flowering bushes and slender trees, with the deep blue ocean and pale luminous sky stretching beyond. "Out of this composition," writes Puvis de Chavannes, "others have developed which answer to the four great expressions of the human mind, Poetry, Philosophy, History, Science." On the right-hand wall of the staircase as one enters appear in three panels: (1) Pastoral Poetry (Virgil); (2) Dramatic Poetry (Æschylus and the Oceanides); (3) Epic Poetry (Homer crowned by the Iliad and Odyssey).

Puy, Le, lë pü-ë, France, arrondissement and capital city of the department Haute Loire. (1) The arrondissement, a little to the south-east of the centre of the department has an area of 8,680 square miles and a population of about 145,716, and is divided into 14 cantons and 115 communes. Its capital and that of the

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department is (2) Le Puy, or Le Puy-en-Velay, lying at the confluence of the Dolezon and the Born, on the sides and top of the Mont Anis (whence its mediæval Latin name of Anicium or Podium Anicense), so that its least elevation is about 2,050 feet above sea-level and its greatest, the volcanic dike called the Rocher de Corneille about 2,500. It is ill-built but picturesque. The Rocher de Corneille is topped by a statue of Notre Dame de France made from Russian cannon taken at Sebastopol. The city is a bishop's seat and has a cathedral at the top of a staircase with 136 steps; other important buildings are an old chapel of the Templars, known as Diana's temple, the Gothic church of St. Michel d'Aiguille (962-984), the splendid marble and bronze Crozatier Fountain, and the Crozatier Museum, which is especially rich in exhibits of the industries of the town. These are chiefly laces, especially guipure, tulle, woolens, bells and clocks.

Puy-de-Dôme, pû-ê-dê-dôm, France, a central department of the Auvergne, bounded on the north by Allier, on the east by Loire, on the south by Haute-Loire and Santal, and on the west by Corrèze and Creuse, and so named from the peak 4,086 feet in the Puy-de-Dôme group of volcanic mountains in the northern part of the department. The southern range, called Mont-Dore is higher, and the geology and mountain structure of the region is interesting. The highlands are excellent pastures; rye and oats grow at more moderate elevations; and vineyards, wheat, hemp, and flax-fields cover the lowlands. The forest timber is valuable, as are the mineral waters and the coal deposits. Capital, Clermont-Ferrand (q.v.). Area 3,070 square miles.

Puyallup (poo-yă'l'up) **Indians**, an American tribe, similar to the Nisqually family in Washington and Oregon. They formerly occupied all the region about the Puyallup River. Less than 500 of them were living in 1903 on a reservation near Tacoma.

Puzzola'na. See CEMENT.

Pyæmia (formerly suppurative fever, purulent infection, purulent diathesis, etc.) no longer means pus in the blood, but is a form of blood-poisoning (q.v.) of microbic origin, septic infection due to the absorption of pyogenic germs. The typical pathological condition is the production of multiple abscesses in tissues remote from the seat of injury, produced by living bacteria (forms of cocci probably) transported by the blood. Various experiments have shown that pus taken up by the blood-current does not produce pyæmia unless it contains virulent microbes. Sometimes the abscesses of pyæmia are metastatic or embolic, caused by the lodgment of infected emboli in arterioles or veinlets, the inflammation of these vessels and its extension to surrounding areas. Formerly when antiseptics was unknown it was quite common. At the present time pyæmia is infrequent, except where injuries are much neglected. Yet it may begin in the veins of the face and the sinuses of the cranium, from acute and chronic otitis media, etc. It may be associated with or precede septicæmia (a poisoning due to living bacteria in the blood), and death may result from the general infection of the system. Fortunately absorbed virulent microbes are some-

times killed or neutralized by leucocytes, by the chemical bodies called by Buchner sozins and alexins, by the tissue-cells of the liver, spleen, etc., or may be excreted in a living state by the glandular excretory organs. The onset of pyæmia is marked by depression of the vital powers, chills, fever, sweating, and sometimes jaundice; by a coated dry tongue, a rapid feeble pulse, a foul breath; by constipation, followed by foul-smelling loose movements and by scanty high-colored urine. When these symptoms follow a surgical operation or an injury, and abscesses are not so superficial as to be discovered, deep-seated ones are surmised.

The treatment is preventive and curative. See that the patient's power of resistance is not lowered. Keep the bowels and kidneys active. Intestinal putrefaction must not occur. Sunlight, good air, and nourishing food are necessities. As yet no reliable serum-injection has been found to grant immunity. Wounds should be treated antiseptically, and abscesses be antiseptically opened, cleaned, and drained. Stimulants, quinine, and other tonics are indicated.

Pyat, pē-ā, **Felix**, French journalist and politician: b. Vierzon, France, 4 Oct. 1810; d. Saint Gratien, France, 5 Aug. 1889. He studied law and was admitted to the bar in 1831, but confined his attention chiefly to literature and politics. He was an advocate of the attempted insurrection in 1849, a signer of Ledru-Rollin's appeal to the populace, and was forced to escape from France after the failure of the plan. He busied himself in forming further schemes for revolution, living successively in Switzerland, Belgium and England, and was a member of the "European revolutionary committee." When the general amnesty was granted in 1870 he returned to France, speedily attained leadership among the Paris Communists and was prominent in the destruction of the Vendôme column. The fall of the Commune rendered flight again imperative and for his part in the Communal government he was tried and placed under sentence of death in 1873, though then absent from France. He was pardoned in 1880, returned to France and in 1888 was elected deputy from Marseilles.

Pycnogon'ida. See PANTOPODA.

Pydna, pîd'na, in ancient history, a city of Pieria in Macedonia, originally on the west coast of the Thermaic Gulf, but removed three miles inland by Archelaus. The Athenians controlled it for a time, but lost it to Philip the Great. In 168 B.C. at the battle of Pydna Perseus of Macedon was utterly defeated by the Romans under Æmilius Paulus, the death-blow of the Macedonian empire. In Byzantine times the city of Kitron or Kitros grew up on the same site, and this name is borne by the present town.

Pye, pî, **Henry James**, English poet-laureate: b. London 10 July 1745; d. Pinner, Hertfordshire, 13 Aug. 1813. He was educated at Oxford and in 1784 entered Parliament from the county of Bucks, but played an unimportant part there. He was crowned laureate in 1790 and dutifully fulfilled the expectations of his office in producing his two odes a year. Other verse came from his pen, but nothing that rises above the dead level of commonplaceness. He was made one of the magistrates of Westminster

in 1792. Pye was a voluminous writer, contributed to the literature of the stage and translated Aristotle's 'Poetics.' He seems, however, not to have set great store on his poetry himself, and observed that he had rather be thought a good Englishman than the best poet or the greatest scholar that ever wrote.

Pye, John, English engraver: b. Birmingham 22 April 1782; d. London 6 Feb. 1874. In 1802 he went to London and came under the influence of John Heath. Success in rendering landscape brought him to the attention of Turner, who engaged him to engrave a plate from his 'Temple of Jupiter at Ægina.' A long Turner series of engravings followed. Being a Turner enthusiast he collected one of the finest sets of plates engraved after that master. He published 'Patronage of British Art' (1845), and began the publication of 'Pictures from the National Gallery,' terminated after 29 parts were issued.

Pygmalion, pîg-mă'li-ôn, (1), in Greek legend a son of Clix and grandson of Agenor, king of Cyprus. In the story told by Ovid (Met. x. 243) he conceived an aversion to women and devoted himself to art, but having made an ivory statue he became so enamored of it that he entreated Aphrodite to endow it with life. This was done; the statue became a beautiful woman whom Pygmalion married and by whom he had Paphos, founder of the city of that name in Cyprus. W. S. Gilbert's play, 'Pygmalion and Galatea,' is founded on this story. (2) Tyrian king and brother of Dido. He murdered Dido's husband Acerbas or Sichæus upon which Dido took her dead husband's treasures and sailed for the coast of Africa where she founded Carthage.

Pygmies, the name given by the ancients to a race of dwarfish men reported as existing in various parts of the world. Homer (Il. iii. 6) fixes the habitat of the pygmies in the far south-land whither the cranes migrate at the approach of winter; after Homer the battles of the cranes and the pygmies are a favorite theme of poets, and are often pictured on vases. Ancient authors, whether travelers, historians, or miscellanists, like Herodotus, Ctesias or Pliny, describe the pygmæi as little men, the tallest of them not exceeding in height two *pygmæ* (Gr. *pygme*, a measure of length, the distance from the elbow to the knuckles—less than 14 inches). Herodotus locates his pygmæi in the heart of Africa in a region traversed by a great stream—probably the Niger—flowing from west to east, and modern geographical research gives support to his story after it had long passed for fabulous. In recent times the actual existence of pygmies has been ascertained beyond any question, though when Paul B. Du Chaillu (q.v.) in 1861 published his 'Explorations and Adventures in Equatorial Africa' his description of the pygmy tribes discovered by him was scouted by scientific men as mere fiction. But when his report was confirmed in every essential particular by the missionary Father des Avanchers (1869), by Schweinfurth (1871), by Stanley (1876) and others, scientific skepticism gave way, grudgingly, to conviction of Du Chaillu's good faith. Many different tribes of pygmies are now recognized as existing in the interior of Africa, all possessing these characteristics: stature ranging from 33 inches to 4 feet 4 inches, as reported

of the Wambutti by Stanley: Schlichter makes the average stature 4 feet 6 inches; complexion, from yellowish brown to reddish brown; usually heavy growth of hair on body and face—a curious item of accordance with the report of Ctesias regarding the pygmæi of India, who had "beards and hair so long as to serve for vesture"; retreating forehead, prognathic jaw; fingers long, tapering, and feet strongly arched; in their villages the huts (8 feet long, 5 feet wide, 4 feet high) are clustered round the hut of the chief; their usual food is vegetable, but they eat almost anything: in hunting they show great intelligence; one tribe, the Wambutti, devise exceedingly ingenious nets, nooses and traps for securing game great and small.

Pylades, pî'la-dêz, a legendary Greek hero, celebrated for the friendship which existed between him and Orestes. He assisted Orestes in murdering his mother Clytæmnestra, and eventually married Electra, the sister of his friend. See ORESTES.

Pyle, pil, Howard, American artist and author: b. Wilmington, Del., 5 March 1853. He combines literary and artistic talent and in this double capacity began his career in New York city by contributing to various periodicals. Having achieved a position he returned to his native place where he has resided since 1879. He has been instructor at the Drexel Institute, Philadelphia, but his time is largely occupied with original productions for current periodicals. In art he especially affects scenes of colonial life and of mediæval folk-lore and is remarkably successful in conveying their spirit. Some of the finest achievements in color printing in the magazines of recent times have been from his drawings. Works of which he is both author and illustrator are 'The Merry Adventures of Robin Hood' (1883); 'Pepper and Salt, or Seasoning for Young Folks' (1885); 'Within the Capes' (1885); 'The Wonder Clock' (1887); 'The Rose of Paradise' (1887); 'Otto of the Silver Hand' (1888); 'A Modern Aladdin' (1891); 'Jack Ballister's Fortunes' (1894); 'Twilight Land' (1895); 'Semper Idem' (1903). He also wrote 'Rejected of Men' (1903), the story of the Christ in modern setting.

Pylos, pi'lôs, or **Pylus**, three ancient Greek cities. (1) Pylos in Elis, on the Peneus and Ladon, was an outpost of the Eleans. (2) Pylos in Triphylia, modern Biskini, east of Mount Minthus, was reckoned Nestor's city by Strabo; but this honor is now generally bestowed on (3) Pylos, a city on the western coast of Messenia, on the present gulf of Navarino. If this identification be accepted, Pylos must have been a flourishing city in Homeric times. It resisted Sparta after the second Messenian war, and upon the fall of Ira the inhabitants deserted the city and settled mostly in Sicily. The Athenian general Demosthenes seized the ruined city early in the Peloponnesian war, 424, intending to make it the rallying point for the Messenian disaffection against Sparta. He got a strong position on the eminence called Coryphasium, but was hemmed in on land and sea by the Spartans, who made Sphacteria their base. Demosthenes beat them back by land, the Athenians defeated the Spartan fleet and the Athenians perfected the blockade of the island of Sphacteria. Demosthenes, reinforced by Cleon, who took all the

glory, burned the woods on the island and forced the Spartans to surrender. (See PELOPONNESIAN WAR.) The city was rebuilt by Epaminondas, who attempted to raise up a new Messenian nation. The present name is Navarino, either because of an Avar colony (so originally Avarino) or because of a Navarrese settlement in 1381. See NAVARINO.

Pym, pīm, John, English statesman: b. Brymor, Somersetshire, 1584; d. London 8 Dec. 1643. He was educated at Oxford, and in 1602 entered the Middle Temple, but was never called to the bar. He became member of Parliament for Calne in 1621, but from 1625 sat for Tavistock. He was prominent in the impeachment of the Duke of Buckingham in 1616, and in 1639, with several others, held close correspondence with the commissioners sent to London by the Scottish Covenanters. When Parliament met again in 1640, Pym was one of its most active and leading members, and in the Long Parliament, which met later that same year, he came most prominently to the front. Possessed of great eloquence, he made a vigorous and effective speech as soon as Parliament had opened, dwelling at length upon the grievances of the nation with respect to parliamentary privileges and civil and religious liberty. A few days after he followed up his speech by bringing a charge of high treason against the Earl of Strafford, prime minister of Charles I.; and in the impeachment which followed, resulting in the death of Strafford, he took the leading part. In 1641 a motion was carried by the opposition party to submit a remonstrance to the king exposing the defects of his administration since ascending the throne, and the zeal of Pym in this matter led Charles into the imprudent measure of going to the Parliament in person to seize him and four other members. Clarendon relates that Charles I., feeling the necessity of gaining at any cost an enemy at once so implacable and so skilful, offered to Pym the post of chancellor of the exchequer. In November 1643, he was appointed lieutenant of the ordnance, but died the following December. He was buried with great pomp in Westminster Abbey. Consult: Forster, 'Statesmen of the Commonwealth' (1841-4); 'The Arrest of the Five Members' (1860); and 'The Debates on the Grand Remonstrance' (1860); Goldwin Smith, 'Three English Statesmen' (1867); S. R. Gardiner, 'The Great Civil War' (1893).

Pyncheon, Thomas Ruggles, American Protestant Episcopal clergyman and physicist: b. New Haven, Conn., 14 Jan. 1823. He was graduated from Trinity College in 1841, was lecturer on chemistry there 1843-7, studied for the ministry, and was ordained priest in 1849. In 1849-55 he was in charge of parishes in Stockbridge and Lenox, Mass., and in 1854 accepted the chair of chemistry and natural science at Trinity College which he held until 1877 when he exchanged for the chair of moral philosophy. He was president of the college 1874-83. In 1874-8 he superintended the erection of the college buildings on the west side of the quadrangle and the transfer of the college to the new site. While in Europe 1855-6 he made a tour through southern France, Italy, and Sicily, engaged in geological investigations, made a study of volcanic action, and ascended Mount Ætna at

night. In 1902 he became professor emeritus at Trinity. He is a member of the American Academy of Arts and Sciences, was one of the founders of the Meteorological Society, of which he is vice-president, and is connected with various other scientific societies both American and foreign. He has published: 'Treatise on Chemical Physics' (1869); 'An Examination of Bishop Butler's Analogy' (1890).

Pynchon, William, American colonist and religious writer: b. Springfield, Essex, England, 1590; d. Wraybury, England, 29 Oct. 1662. He was a man of education, one of the grantees of the Massachusetts charter and came to America with Governor John Winthrop in 1630. He held various offices in the colony, from 1632 to 1634 acting as treasurer. He first settled at Roxbury as one of the founders of the village and organizers of the church, but withdrew in 1736 with the company led by Rev. Thomas Hooker and Rev. Samuel Stone southward into Connecticut. Pynchon with his family and a small party settled at the junction of the Agawam and Connecticut rivers and founded the present town of Springfield. For several years this place was included in the Connecticut colony and Pynchon sat in its legislature, but in 1641, under Pynchon's influence, the Massachusetts court assumed jurisdiction. In 1650, during a visit to England, Pynchon published a book entitled 'The Meritorious Price of our Redemption.' In this the author took an anti-Calvinistic view of the atonement and so stirred up the colonists that the book was ordered to be burnt and the author cited to appear before the general court. His letter of explanation was deemed unsatisfactory and after being summoned a second time he left the colony in September 1652 and returned to England. He passed the remainder of his life at Wraybury, near Windsor. His earlier book was republished with a rejoinder to the Rev. J. Norton, as 'The Meritorious Price of Man's Redemption' (1655). He also wrote 'Jews Synagogue' (1652); 'How the first Sabbath was ordained' (1654); 'Covenant of Nature made with Adam' (1662). Consult: Green, 'Springfield, 1636-1886: History of Town and City' (1888).

Pypin, Alexander Nicolaevitch, Russian scholar, historian and author: b. at Saratov in 1833; d. Saint Petersburg 9 Dec. 1904. Received his academic education at the University of Saint Petersburg, where he was appointed to a professorship in 1860, resigning two years later to enter the literary field. He contributed largely to the *Sovremennik* ("Contemporary"), 1865-7, and from then until his death to the *Vestrik Evropy* ("European Messenger"). His first work, a comparative study of Russian, Byzantine and Roman folk-lore, was published in 1859, followed by a 'History of Slavonic Literatures' (1865), 'The Intellectual Movements in the First Half of the 19th Century,' and a masterly biography in two volumes of Byelinski, the critic, in 1876. A four-volume work, 'The History of Russian Ethnography,' was published in 1892-4, and the 'History of Russian Literature' in 1898-9. In 1897 he was appointed a member of The Academy of Sciences of Saint Petersburg, publishing for them the works of Catharine II.

Pyral'idæ, a family of moths (q.v.).

PYRAMID

Pyramid, in architecture, a structure of masonry generally having a rectangular base and four triangular sides terminating in a point. According to Herodotus the Egyptians considered the pyramidal form as an emblem of human life; the broad base was significant of the beginning, and its termination in a point of the end of our existence in the present state; for which reason they made use of this figure in their sepulchres. The most remarkable pyramids are those of Egypt and Nubia and those of Mexico. The Egyptian pyramids have for ages been a source of interest and curiosity, and in ancient times were regarded as forming one of the seven wonders of the world. They are built mainly of a hard limestone, but large blocks of granite are also used, especially on the outside. The four sides are so placed as to face the four cardinal points. Being intended both as monuments and as tombs, they contain one or more sepulchral chambers, quite small compared with the total mass. They appear to date from the period of the 3d dynasty to the 12th (say 2500-2000 B.C.), after which none were built. Each pyramid was commenced over a sepulchral chamber excavated in the rock, and the work went on during the lifetime of the king for whom it was intended. A low narrow passage was kept open as the tiers of stone were added, in order that access might be obtained to the central chamber from without; and when the monarch died the work ceased, and the last layers were then finished off and the passage closed up. The angles formed by the recession of each superior layer were filled up with small stones and beveled off, so as to give a smooth sloping surface to the sides. The stones used varied in thickness from 2 feet to 4 feet, and the mechanical skill requisite to quarry these and to raise them to such great heights and adjust them in their proper places continues a matter of universal astonishment. No indication of the mechanical contrivances used for this purpose has been left, though that they possessed such can hardly be doubted. The fact that an almost fabulous number of laborers were engaged in erecting these pyramids did not lessen the necessity for the employment of certain machines. The pyramids now standing, all in Middle Egypt, are divided into five groups, containing in all about 40 pyramids. The district in which the pyramids stand begins above Dashur, and extends by Sakkara and Memphis along the western margin of the valley of the Nile for about 60 or 70 miles, the last or Gizeh group being but a few miles above Cairo. The group of Gizeh, in the neighborhood of the ancient Memphis, is the most remarkable. It consists of nine pyramids, and comprises the three most celebrated monuments of the kind in existence, namely, the pyramid of Cheops, called the Great Pyramid; that of Cephren, and that of Mycerinus—the last much smaller than either of the others. According to Herodotus the Great Pyramid was built by Cheops. It took 100,000 men working for 10 years to make a causeway 3,000 feet long, to facilitate the transportation of the stone from the Turah quarries; and the same number of men for 20 years more to complete the pyramid itself. Herodotus further describes the method of building by steps, and raising the stones from layer to layer by machines, and finally of facing the external portion from the

top down. Diodorus calls the builder of this pyramid Chembes or Chabryes, and by Manetho and Eratosthenes he is called Suphis. The latter name corresponds to Shufu, deciphered from the hieroglyphics upon some stones discovered by Colonel Vyse in his important investigations of this pyramid in 1835. The pyramid at present covers an area of more than 12 acres. The base is about 750 feet square, but was formerly about 768 feet. The perpendicular height, which before the disappearance of the apex was about 482 feet, is now 451 feet. The area at the top is about 12 yards square. The outer casing of small stones has been removed, and the appearance the sides now present is that of a series of ascending steps. By these steps, which number 203, the ascent is made comparatively easy, though the lower ones are 4 feet 10 inches high. The content of solid masonry has been estimated at 82,111,000 cubic feet. The only entrance is on the north face, 49 feet above the base, though the masonry about it has been so much broken away that the débris reaches nearly up to it. A passage 3 feet 11 inches high and 3 feet 5½ inches wide conducts from the entrance down a slope at an angle of 26° 41', a distance of 320 feet 10 inches, to the original sepulchral chamber, commonly known as the subterranean apartment; it is carried, reduced in dimensions, beyond this a distance of 52 feet 9 inches into the rock, though for what purpose remains a matter of conjecture. The sepulchral chamber is 46 feet long by 27 feet wide, and 11½ feet high. From the entrance passage another branches off and leads to several other passages and chambers. One of the latter, known as the queen's chamber, is situated about the centre of the pyramid, 67 feet above the base; it has a groined roof, and measures 17 feet broad by 18 feet 9 inches long, and 20 feet 3 inches high. The other, called the king's chamber, is reached by an offshoot from the queen's passage, 150 feet long. Its dimensions are 34 feet 3 inches long by 17 feet 1 inch wide, and 19 feet 1 inch high. The chamber is lined with red granite highly polished, single stones reaching from the floor to the ceiling, and the ceiling itself is formed of nine large slabs of polished granite extending from wall to wall. The only contents of the apartment is a sarcophagus of red granite, which, judging by its dimensions, must have been introduced when the building was proceeding. It is supposed to have contained a wooden coffin with the mummy of the king, and that these long since disappeared when the pyramids were first opened and plundered. The second pyramid, built by Suphis II. or Cephren, stands on a higher elevation than the Great Pyramid. Its original dimensions were 707 feet 9 inches square, and 454 feet 3 inches high; but these now stand 690 feet 9 inches and 447 feet 6 inches respectively, with an angle for its slope of 52° 20'. Part of the outer casing of the pyramid is still preserved. This pyramid has two entrances, and the passages to which they respectively give access lead to the same sepulchral chamber, in which is deposited a granite sarcophagus. It was reached with great difficulty by Belzoni in 1818. Belzoni found in it a Cufic inscription recording the visit of the Caliph Alaziz Othman Ben-Yusuf, and the opening by him of the pyramid in 1196 A.D. The only remains met with were those of a bull. The third pyra-

PYRAMID—PYRENEES

mid, built by Menkaré or Mycerinus, is only 354 feet 6 inches square and 203 feet high. It also was explored by Colonel Vyse in 1837. He discovered several chambers, one of which contained a sarcophagus and a mummy case bearing the name of King Menkaré, and also a body, supposed to be that of an Arab. The two latter are now in the British Museum, but unfortunately the sarcophagus was lost by the sinking of the vessel in which it was being transported to this country. This pyramid is the best constructed of the three; it was originally cased half-way up with black granite. The six smaller pyramids which complete the Gizeh group are supposed to form the tombs of some of the relatives of the kings who constructed the larger ones, and are of much inferior interest to the three above mentioned. Of the other groups of pyramids that at Abusir contains five; another at Sakkara contains eleven, one with a doorway inlaid with porcelain tiles and having a royal name; and a third group at Dashur contains five. Other pyramids are at Meydun and Illahun, and there are two at Biahmu. The pyramids of Nubia are very numerous; a single group north of Gebel Barkal comprises no fewer than 120. In Babylonia the Birs Nimrud or Tower of Belus was a kind of step-shaped pyramid, built of bricks of different colors. It was erected by Nebuchadnezzar, and dedicated to the planets. Its height was 235 feet and its circumference 2,286 feet. The Mujellibe in Babylon, of which the ruins are still to be seen, was another pyramidal structure of the same monarch. Ruins of pyramids are to be found at Benares in India and in other parts of the East. Certain monuments of the ancient inhabitants, found in Mexico, are also called pyramids. (See MEXICAN ARCHÆOLOGY.) Consult: Lepsius, 'Ueber den Bau der Pyramiden'; Vyse, 'Operations carried on at Gizeh in 1837'; Petrie, 'The Pyramids and Temples of Gizeh' (1884); Maspero, 'L'Archéologie Egyptienne' (1887).

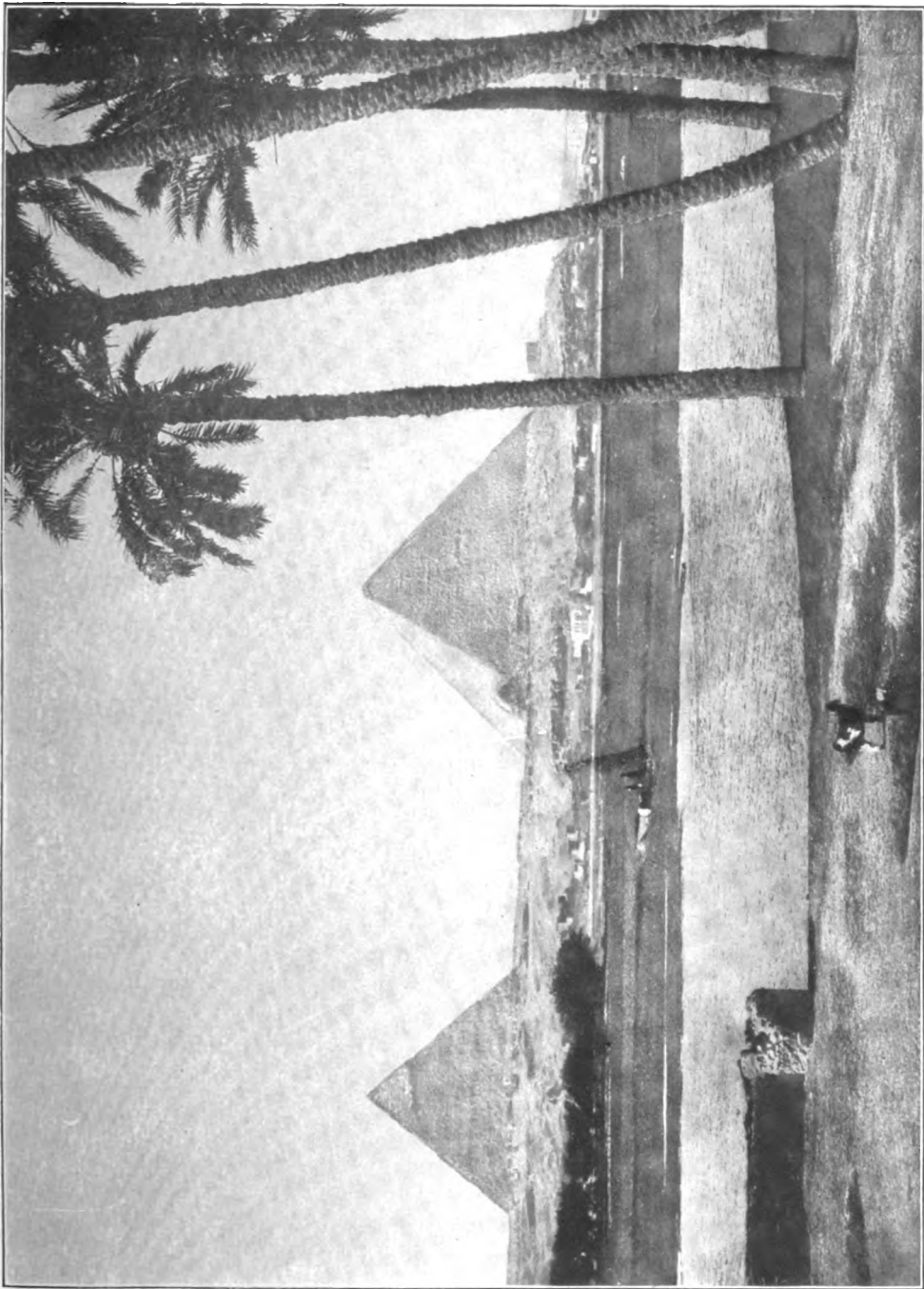
Pyramid, in geometry, a polyhedron with a polygon as base, and triangular sides meeting in a common point called the vertex. The regular pyramid is bounded by four equilateral triangles with the vertex perpendicular to the centre of the polygonal base, and is thus a tetrahedron. The perpendicular distance between the base and the vertex is the altitude. The *slant* altitude is the height of any of the triangular sides. Pyramids are named according to the natures of their bases; they may be triangular, quadrangular, etc., according as their bases are triangles, quadrilaterals, pentagons, etc. The base and lateral triangles are called faces; the lines in which the faces meet are called edges; the points in which the edges terminate are called the vertices of the pyramid.

Pyramus (pîr'a-mus) and **Thisbe**, thîz'bē, a pair of unfortunate lovers whom classical legend represents as living in Babylon. Their parents were enemies and would not sanction the marriage of the lovers, but the two contrived to converse with each other in secret through an opening in the walls of their adjoining houses. They finally determined upon a meeting at the tomb of Ninus. Thisbe was first to arrive and meeting a lioness who had just killed an ox she ran away, dropping her mantle in her flight. This the lioness soiled with blood and

Pyramus arriving shortly after and finding the blood-stained garment of his betrothed imagined her to have been killed and ended his life beneath a mulberry tree, the fruit of which has since been of a blood-red hue. Thisbe returning finds the body of her lover, whereupon she then kills herself in despair. The legend is embodied in Ovid's 'Metamorphoses' and is caricatured in the farcical interlude in Shakespeare's 'Midsummer Night's Dream.'

Pyrargyrite, pî-râr'jî-rît ("dark ruby silver"), a rhombohedral mineral, usually of high metallic-adamantine luster, color black by reflected light, rich ruby-red by transmitted light, hardness 2.5, specific gravity 5.85. It is a silver sulph-antimonite, containing 60 per cent of silver. It occurs in magnificent specimens in Germany, Mexico, Chile and Bolivia, and is an important silver ore in these countries and in the mining regions of the Western United States.

Pyrenees, pîr'e-nēz, a lofty mountain chain forming the boundary between France and Spain. Its length, from Cape Creux, north of the Gulf of Rosas, to the Point of Figuer, near Fuenterrabia, is nearly 270 miles; and its breadth near the centre, where it is greatest, scarcely exceeds a third of the length. Though the chain thus defined terminates at two opposite seas, it cannot be said to be isolated, since to the west it is obviously continued across the north of Spain by the Cantabrian Mountains. The direction of the chain is east-southeast, to west-northwest. It does not, however, lie in the same straight line, but rather consists of two lines, which form parallel ridges about 20 miles distant from each other, except near the centre, where they become united by means of a remarkable rectangular elbow, in which some of the loftiest summits are found. Both on the north and south sides numerous branches are thrown off, generally at right angles to the principal axis, and subside rapidly as they recede from it, forming various transverse, but very few longitudinal, valleys. The chain rises both from the east and west toward the centre; and, in accordance with a general rule which holds in regard to the European chains, which lie in the direction of the equator, the descent on the south side is much more abrupt than on the north. Owing to this the south has much fewer lakes than the north slope, but far surpasses it in the boldness and grandeur of its scenery. As already observed, the loftiest summits of the chain are near its centre. Its culminating point, Maladetta, situated there, has the height of 11,168 feet, and a great number of peaks in the same locality exceed 8,500 feet. To the east of the centre the chain lowers so rapidly that its average height soon becomes little more than 2,000 feet. To the west the height diminishes much more gradually, and many peaks have heights varying from 5,000 to 7,000 feet, and even 8,000 feet. The principal passes in the Pyrenees formed by the meeting of valleys from opposite sides of the axis, take in the east part of the chain the name of Cols, and toward the centre that of Ports. No fewer than 75 are counted, of which 28 may be crossed on horseback, and 7 in wheeled carriages. The most frequented are those of Pertus and La Perche in the east, and St. Jean Pied de Port in the west. The nucleus of the chain is evidently granite, which.



THE GREAT PYRAMIDS, NEAR CAIRO.

PYRENEES — PYRITE

with the primitive schists which overlie it, constitutes the loftiest summits, with the exception of Mont Perdu (10,994 feet), Marbore (10,673 feet), and some huge adjacent masses which are formed of mountain limestone. The granite, however, seldom forms continuous ridges along the principal axis, but rather appears in a number of remarkable protuberances situated to the north of it. Above the micaceous schist and primitive limestone, which occur in connection with it, lie largely-developed strata of argillaceous schist and transition limestone, forming two great belts parallel to the primitive chain, one on the north and the other on the south side. Above these secondary rocks appear, of which by far the most common is the mountain limestone, which occupies the greater part of the south slope, but on the north side attains little elevation, being there almost entirely confined to the lower heights at the bottom of the principal chain. Above the mountain limestone the principal rocks are Jura limestone and trap. The number of thermal springs existing in the Pyrenees seems to indicate the presence of volcanic agents, but basalt and other rocks of igneous origin are very rare. The minerals of the chain include iron, copper, lead, zinc, manganese, antimony, and cobalt. There is no mine either of silver or gold, but particles of the latter are found in department Ariège, and in the streams of several other districts. The only mineral which has hitherto been worked to much advantage is iron. Mineral springs, both cold and thermal, are numerous, and much frequented by visitors. The limit of vegetation on the Pyrenees is about 600 feet higher than on the Alps. The rhododendrons, which in the latter are not found higher than 5,000 feet, are here found at 5,500 feet, and alpine plants are found on the loftiest summits bordering on the region of perpetual snow. In the Pyrenees this is found only on the north slope, where it does not, as in the Alps, form a snowy zone, the lower limit of which looks as if traced out by an almost horizontal straight line; but, on the contrary, forms large isolated masses, the base of which is often concealed by the mountains in front of them. This makes it difficult to fix the snow-line with precision, but according to the most accurate estimate it is 9,190 feet, or nearly that of Mount Canigou. Glaciers are not numerous in the Pyrenees, and hence the torrents and rivers which rise in the chain are fed chiefly by springs. Those on the south side flow toward the Ebro, and are carried by it to the Mediterranean; those on the north side flow partly to the Mediterranean and partly to the Atlantic, the water-shed between the two seas being carried northward by a branch which ultimately links with the Cevennes. The largest river of the chain, and the only one of importance which preserves its name throughout its whole course, is the Garonne. In respect of average height and mass the Pyrenees are unquestionably the second mountain chain of Europe, but its culminating point, Maladetta, has only the third place, being indeed lower than Mulhacen in the Sierra Nevada. Contrary to the general rule, that the loftiest summits of mountain chains are found in the line of the principal axis, Maladetta, Posets (11,047 feet), and Mont Perdu, the three culminating points of the Pyrenees, are situated on the south slope.

Consult: Taine, 'Voyage aux Pyrénées,' especially the 4th ed. (1873) with illustrations by Doré; Schrader, 'Les Pyrénées,' in the 'Annuaire du Club Alpin français' (1885); De Margerie and Schrader, 'Aperçu de la Structure géologique des Pyrénées' (1891), and 'Aperçu de la Forme et Relief des Pyrénées' (1892); Camena d'Almeida, 'Les Pyrénées: Développement de la Connaissance géographique de la Chaîne' (1893); Trutat, 'Les Pyrénées' (1894); Bubanus, 'Flora Pyrenæa' (1897-1902); Spender, 'Through the High Pyrenees' (1898).

Pyrenees, Peace of the, in European history, the name given a treaty concluded between France and Spain by Cardinal Mazarin and De Haro, on the Ile des Faisans, in the river Bidassoa, 7 Nov. 1659, terminating a war which had lasted for 24 years. By this treaty Spain ceded to France Roussillon, with the fortress of Perpignan, etc., so that the Pyrenees have since formed the boundary of the two kingdoms; and in the Netherlands, Artois, and part of Flanders, Hainault, and Luxemburg, with a number of fortified towns.

Pyrethrum, a group of composite plants formerly considered a genus but now ranking as a section of the genus *Chrysanthemum*. In garden literature the name is generally restricted to *Pyrethrum roseum*, several hundred varieties of which are widely popular in European gardens. Under the name *Chrysanthemum coccineum* it is extensively cultivated in southern France, California and western Asia for its flowers, which are dried and ground as the material of insect powder. Another species (*C. cinerariæfolium*) is also cultivated for this purpose. The well-known bedding-plant "golden feather" is a variety *C. præatum*, but is widely known as *Pyrethrum aureum* among horticulturists. The plants are easy to grow in any good garden soil, if deeply dug and highly enriched. Since the seed is often disappointing in its results, the plants are best propagated from choice varieties by division in the spring. The golden-feather pyrethrum is often propagated by cuttings made during the winter from stock plants.

Pyrgos, pîr'gōs, Greece, capital city of the nomos of Elis, 13 miles west of Olympia, on the west coast of the Morea, near the mouth of the Ruphia (Alpheus), on the railroad from Piræus to Olympus, and with branch connections with its harbor, Katakolon. The surrounding country is a fertile plain, growing currants, oranges, and grapes. The commune has a population of about 27,000; the town, 13,000.

Pyreheliometer, an instrument for measuring the intensity of the heat of the sun. It is a shallow, circular vessel of silver, having one side coated with lampblack, containing mercury or water, and having a thermometer let into it.

Pyridine (C₅H₅N), a mobile liquid, boiling at 117°, obtained by the distillation of various organic substances, such as peat, bone, coal naphtha, etc. It has an alkaline reaction, and forms salts with acids.

Pyrite, or **Iron Pyrites,** the commonest metallic mineral, like copper pyrites, is often called "fool's gold," owing to its resemblance to gold. It may readily be distinguished by its much greater hardness, 6 to 6.5, brittleness, pale brass-yellow color, greenish-black streak, and

PYRITES — PYROMETER

specific gravity, 4.95 to 5.10. It crystallizes in isometric crystals often of great beauty, but is usually found massive as a vein material or in beds of great extent. It is an iron disulphide, FeS_2 . Its high sulphur percentage, 53.4, and the ease with which it may be burned, leads to its enormous consumption in the manufacture of sulphuric acid. Owing to its ready oxidation, it is an active agent in the disintegration of those rocks through which it is disseminated. It frequently contains gold and to some extent other valuable metals. Its most importance commercial occurrence is at Rio Tinto, Spain. It is also extensively mined near Rowe, Mass., in Virginia, the Carolinas, Georgia, Colorado and in many other regions. The finest crystals come from Elba, Cornwall in England, Peru, Chester County, Pa., and Central City, Colo.

Pyrites, either of the various metallic sulphides, of which the most important is iron pyrites (see **PYRITE**). Copper pyrites (see **CHALCOPYRITE**) is an important ore of copper. Arsenical pyrites (see **ARSENOPYRITE**) furnishes much of the arsenic of commerce; magnetic pyrites (see **PYRRHOTITE**) is often an important nickel ore.

Pyrmont, pēr'mōnt, Germany, a celebrated watering-place of Prussia, in the principality of Waldeck and Pyrmont, capital of the district; in a beautiful valley at the foot of a range of finely wooded hills, on the left bank of the Emmer, 34 miles south-southwest of Hanover. It contains a palace, in which the Prince of Waldeck and Pyrmont resides during the watering season; and it is much frequented, particularly by the aristocracy of Germany; from 10,000 to 20,000 visitors are here annually. One of the curiosities of the place is the *Dunsthöhle* or gas grotto, which emits vapors similar in nature and effect to those of the Grotto del Cane in Italy. Pop. (permanent) 1,500.

Pyrochlore, a dark brown, resinous mineral of complex composition, essentially a cerium and calcium niobate, but of interest because containing also thorium and uranium. It occurs in octahedrons in Norway and Russia.

Pyrogalllic Acid, **Pyrogallol**, **Tri-oxy-benzene**, $\text{C}_6\text{H}_3(\text{OH})_3$, is produced by action of heat on gallic acid, carbon dioxide being eliminated in the process. Fine colorless needles or plates, readily soluble in water, less so in alcohol or ether, melting point 132°C . Valuable because of its great affinity for oxygen, its alkaline solution is used to absorb oxygen in gas analysis. It is used extensively as a photographic developer, but has the disagreeable power of darkening the skin. It forms a number of derivatives, some being valuable dyestuffs.

Pyrography, from *πῦρ*, fire, and *γράφειν*, to write, literally to write by fire. A method of making impressions on wood, leather, etc., by means of heated metallic instruments. The art was early practised by the Egyptians who used crude iron bars that had been previously heated in fire. The modern form of this kind of apparatus consists of a tube about six inches in length and about half an inch in diameter provided at its lower extremity with a screw-cap and a small support. At the other end there is a rod to which the drawing point is affixed. For the formation of the combustible gas

and heating of the rod sulphuric ether is usually employed. The gas when generated is forced to the metallic point by means of air pressure and after the flame has been regulated a person may work for two consecutive hours at an expense of about one half cent per hour. The vapors disengage themselves constantly and feed the small flame which is barely perceptible. The heat is always uniform, and even on leather a sure and sharp execution of the design is possible. The effects produced by the pyrograph are equal in many respects to the fine crayon drawings, and when colored and varnished present a very pleasing effect. The finest and most delicate lines can be drawn and there is no danger of burning holes in the material. The right hand being engaged in the execution of the piece to be ornamented leaves the left free to turn the object in any desired position while the work is in progress.

From a commercial standpoint, work in pyrography offers very good returns. It is taught in most of the trade schools, and by many private masters, and those who apply themselves systematically may use their accomplishment with profit. Apart from the artistic and financial interest the work has a substance and lastingness about it that makes it seem worth while to master.

Pyroligneous Acid, impure acetic acid produced as one of the volatile products of the destructive distillation of wood. The wood is slowly heated in large iron retorts or ovens so arranged that the volatile products may be condensed and gathered. The watery portion contains wood alcohol and acetic acid mixed with small amounts of such impurities as carbolic acid, creosote, and the like. On redistillation the wood alcohol passes over first, leaving the impure acetic acid or pyroligneous acid in the retort. This may be purified (see **ACETIC ACID**) or used as such for various purposes such as the impregnation of wood to prevent decay, etc.

Pyrolu'site, the most important ore of manganese. It is a black or gray mineral of brilliant metallic lustre. It is distinguished from manganite and polianite, which it much resembles, by being so soft (hardness 2 to 2.5) as readily to soil the fingers. Its black streak further separates it from manganite. While its crystallization is orthorhombic, it is usually massive or radiating-columnar. Chemically it is manganese dioxide, MnO_2 . It has long been used in the manufacture of chlorine and oxygen, and in decolorizing glass; its present most important use is in the preparation of manganese-steel. It occurs abundantly in Thuringia and elsewhere in central Europe, also in Nova Scotia and Brazil. In the United States it is mined in Virginia, Georgia and Arkansas.

Pyroma'nia, incendiary monomania, a form of insanity characterized by an irresistible desire to destroy by fire. In most forms of mental disease self-control is lost, but in pyromania the loss of the power of inhibition is the chief symptom; hence the affection is sometimes spoken of as a form of inhibitory insanity.

Pyrom'eter, an instrument for measuring temperatures higher than the boiling-point of mercury (350°C). Regnault and other careful experimenters employed the expansion of air and vapors in measuring high temperatures. These

PYROMORPHITE — PYROXENE GROUP

pyrometers can only be used in a laboratory; for use in a manufactory less accurate methods of measurement have to be employed. In Wedgwood's pyrometer (1782) it was assumed that dry clay, when exposed to heat, contracted regularly, and the instrument was constructed on this principle; but it is now known to be untrustworthy. An instrument in which the expansion of a metal bar (generally of platinum) was magnified by means of levers has often been employed to measure the temperature of a furnace. Morveau, Brongniart, and Daniell invented instruments on this principle. The thermo-electric law of Tait may be used to calculate the temperature to which a junction of copper and iron has been subjected, the electric current produced being measured by a galvanometer. In this way high temperatures have been measured with considerable accuracy. By Siemens' method temperatures are measured by observing the increased electric resistance of a platinum wire when heated, two coils of the same kind of wire being prepared so as to have equal resistances at the same temperature, their ends connected by rather long thick copper wires, and the current from a constant battery passing through them measured by means of a galvanometer. One of the coils is kept at a known temperature, the other has the temperature which it is desired to measure. The law discovered by Siemens—

$$R = a\sqrt{T} + \beta T + \gamma$$

where R is the resistance at the absolute temperature T , and where a , β and γ are certain numbers, enables the temperature to be calculated. Pouillet determined the following temperatures by means of an air-thermometer. They correspond to the stages of incandescence of a metal bar.

Incipient red-heat	525° C.
Dull red	700°
Cherry red	900°
Dark orange	1100°
White	1300°
Dazzling white	1500°

Pyromorphite, a mineral occurring in hexagonal crystals, often cavernous and barrel-shaped, or in curious nearly parallel groups tapering to a point. It is a lead phosphate and chloride and occasionally occurs in sufficient quantities to be an important lead ore. Its hardness is 3.5 to 4, specific gravity, 6.5 to 7.1, color commonly green, yellow or brown, lustre resinous. Its most notable occurrences are Ems, Germany; Cumberland, England; Broken Hill, New South Wales, and in the United States formerly at Phenixville, Pa.

Pyrope, or **Bohemian Garnet**, a fine dark-red variety of garnet, often called "precious garnet" because of its extensive use as a gem. Peridotite, or serpentine derived from it, is the usual matrix of pyrope in Bohemia and in Kimberley, South Africa, but more commonly it occurs as rounded pebbles loose in the sands, as in the ant-hills of the Navajo Reservation in Arizona. It is often incorrectly called "ruby." See **CARBUNCLE**.

Pyrophone, a musical instrument, in which the various notes are produced by the burning of hydrogen gas within glass tubes of various sizes and lengths. It is also called a flame-organ, and was invented about 1875 by a Frenchman called Kastner.

Pyrophyllite, or **Pencil Stone**, a mineral of soapy feel, the compact form of which is extensively mined in North Carolina as soapstone. Its uses are the same as those of the related mineral talc (q.v.). Some of the algamatolite used by the Chinese for carving into pagodas and images is pyrophyllite. The mineral is usually found in coarse lamellar radiations, occurring thus in fine specimens in Switzerland, Georgia, North Carolina and California. Chemically, it is a hydrous aluminium silicate.

Pyroscope, an instrument for measuring the intensity of heat radiating from a hot body, or the frigorific influence of a cold body. It is constructed on the same plan as a differential thermometer.

Pyro'sis, or **Waterbrash**, a disorder of the stomach attended with a sensation of burning in the epigastrium, commonly called heartburn, accompanied with an eructation of watery fluid, usually insipid, but sometimes acid. See **DYSPEPSIA**.

Pyrotechnics, a term applied to the composition, structure, and use of fire-works. The ingredients are nitre, sulphur, and charcoal, together with filings of iron, steel, copper, zinc, and resin, camphor, lycopodium, etc. Gunpowder is used either in grain, half crushed, or finely ground, according to the desired effect. The proportions of the materials differ very much in different fire-works, and the utmost care and precaution are necessary in the manufacture. Lampblack produces a very red color with gunpowder, and a pink with nitre in excess. It serves for making golden showers; yellow mica-ceous sand serves for the same purpose. Verdigris imparts a pale green, sulphate of copper and sal-ammoniac a palm-tree green. Camphor produces a very white flame, with aromatic perfumes, which mask the bad smell of the other ingredients; benzoin and storax are also used on account of their agreeable odor. Lycopodium, which is often used in the manufacture of stage-lighting, burns with a rose color and a magnificent flame. Sky-rockets, an important feature of pyrotechnics, will be found fully described in the article **PROJECTILES**.

Pyroxene, a mineral formed commonly in crystalline limestone or dolomite, in serpentine and in rocks of volcanic origin. Less abundant in granitic rocks and metamorphic schists. Crystalline form, monoclinic. Brittle. Hardness, 5 to 6. Specific gravity, 3.2 to 3.6. Of a vitreous or resinous lustre. Color is usually some dull shade of green, but may vary to nearly colorless or to brownish black. Composition, a metasilicate, $RLiO_3$, where R is Ca, Mg, Fe, sometimes Mu or Zn, rarely the alkali metals. Important varieties of pyroxene are diopside, hedenbergite, schferfite, augite. Pyroxene is one of the most important of the rock-forming minerals being an essential constituent of basalt, diabase trachyte, syenite, gabbro, pyroxenite and many other rocks. It is thus widely distributed in all parts of the world. Especially fine crystals occur in the Piedmont, in Sweden, northern New York and southern Canada, and in New Jersey.

Pyroxene Group, a name given to a group of minerals of which the mineral pyroxene is an important member. Composition, simple silicates of the type $RSiO_3$, where R is Ca, Mg, Fe, sometimes Mu, or Zn, or compound silicates of

PYROXYLIN—PYRRHUS

the types R'' (FeAl), SiO_2 or $R'\text{Al}(\text{SiO}_2)_2$. While the species included in the pyroxene group belong to three distinct crystal systems—orthorhombic, monoclinic, and triclinic—they all have a prismatic angle of 87° , parallel to which cleavage is usually eminent. They are distinguished further by their optical properties. The most important species in the pyroxene group are enstatite, hypersthene, pyroxene, acmite, spodumene, wollastonite, pectolite, and rhodonite.

Pyrox'ylin. See GUN-COTTON.

Pyrrhic (pîr'ik) **Dance**, a famous war-dance of antiquity. It was danced to the sound of the flute, and its time was very quick and light. It was introduced into the Roman public games by Julius Cæsar, and was danced by male and female dancers, having much of a dramatic character. In the mountainous districts of Thessaly and Macedonia a dance called the Romaika, which is supposed to be a modern relic of the Pyrrhic dance, is performed by men armed with muskets and swords.

Pyrrhic Victory, so called from the defeat of the Romans at Asculum 279 B.C. by Pyrrhus, whose losses however were so heavy that the term has become proverbial for a fruitless victory.

Pyrrho, pîr'ô, Greek philosopher: b. Elis about 376 B.C.; d. about 270 B.C. He was a pupil of the Democritean philosopher Anaxarchus of Abdera, whom he accompanied to India in the train of Alexander the Great. During this journey he became acquainted with the doctrines of the Brahmans, Magi, and other eastern philosophers. His doubts concerning positive knowledge were strengthened as he proceeded in his studies, until at length he came to hold all knowledge uncertain, and considered virtue alone as valuable. In all disputes his answer to his opponents was, "What you say may, or may not, be true; I cannot decide," and he taught in his school that truth could not be attained, and that we must be content to suspend our judgment on all subjects. He spent much of his life in solitude, and by abstaining from all decided opinions concerning moral and physical phenomena, endeavored to attain a state of tranquillity unaffected by fear, joy, or sorrow. His countrymen, the Abderites, made him high-priest, and exempted all philosophers from the payment of taxes. The Athenians erected a statue in honor of him, and his countrymen raised a monument to his memory. His skepticism is easily accounted for. His master, Democritus, held that except the immediate elements of bodies (atoms) nothing was real, and that all perception was subjective. He was confirmed in these views by the doctrines of Socrates, to whom, in his character, he bore great resemblance, and his skepticism is allied to the irony of that philosopher. Led by his temperament and manner of life to esteem uninterrupted tranquillity the great object of all philosophy, believing that nothing tended so much to destroy this quiet as the interminable disputes of the schools of the dogmatists, and that uncertainty was increased by their contentions, he determined to seek in some other way the peace which he despaired of finding in dogmatical philosophy. A disposition to doubt is often called, from this philosopher, Pyrrhonism.

Pyrrhonists. See RELIGIOUS SECTS.

Pyrrhotite, pîr'ô-tit, or **Magnetic Pyrites**, a metallic mineral, in composition an iron sulphide, probably FeS_{12} , differing from common iron pyrites, FeS_2 , in percentage composition, in being attracted by the magnet, in its bronze color, inferior hardness (3.5 to 4.5), and specific gravity (4.6). It rarely crystallizes in hexagonal, tabular crystals; usually it occurs massive. Though pyrrhotite contains over 60 per cent of iron and nearly 40 per cent of sulphur, it is only very recently that it has been regarded as of any value for these ingredients. Its commercial value was due entirely to the occasional presence as an impurity of varying percentages of nickel. Formerly the deposits of nickeliferous pyrrhotite at the Gap Mine, Pennsylvania, were extensively worked, but the far richer and more extensive deposits at Sudbury, Ontario, are now the chief sources of nickel. Enormous beds of copper-bearing pyrrhotite, nearly free from nickel, are successfully worked in Vermont. Choice crystallized specimens are found in Austria, Brazil, and at Tilly Foster, New York.

Pyrrhus, pîr'ûs, Greek military leader, king of Epirus: b. about 318 B.C.; d. Argos 272 B.C. He was the son of Æacides, who traced his descent from Pyrrhus, son of Achilles. He spent an eventful youth, regained the throne from which his father had been deposed, and was himself expelled several years later. He became the friend of Demetrius Poliorcetes, whom he accompanied on the fatal campaign closed by the battle of Ipsus (301 B.C.), then proceeded to Egypt as hostage for Demetrius, and there married Antigone, daughter of Queen Berenice. With the aid of Ptolemy Soter he recovered his kingdom (296), agreeing to share the sovereignty with Neoptolemus, who had been king since his expulsion, but soon after put his colleague to death, and succeeded by courage, affability, and generosity in gaining the admiration of his soldiers and people. He temporarily conquered Macedonia and in 280 went to southern Italy at the head of a large army to assist the Tarantines against the Romans. Near Heraclea, on the Siris, the consul M. Valerius Lævinus was defeated by Pyrrhus, whose elephants played an important part in the conflict. Another battle was won, but his loss led Pyrrhus to say, "Another such victory and I must return to Epirus alone." He made proposals of peace to the senate, which were rejected. After having approached within 24 miles of Rome he returned to Tarentum. In 279 he again defeated the Romans, but was glad to accept the offered truce, and passed with his army into Sicily, where he assisted the Greeks against the Carthaginians. At first he met with brilliant success; but his attack upon Lilybæum failed. The war ended in the following year with the total defeat of Pyrrhus by the Romans under Curius Dentatus, near Beneventum. On this occasion the famous elephants of Pyrrhus rushed back upon his own army and contributed to his loss. He reached Epirus with a small remnant of his once splendid army. Nothing daunted, he again invaded Macedonia, and became its king a second time. He afterward turned his arms against Sparta, but was driven from before the walls of that city. In a night attack made upon Argos he was stunned by a tile thrown by a woman from a

PYRUS — PYTHAGOREANISM

house-top, and being recognized by the enemy's soldiers was slain.

Py'rus, or **Pirus**, a genus of fruit-bearing shrubs and trees of the rose family. There are about 40 species, natives of the northern hemisphere and especially of the cool temperate parts. They have usually simple leaves, clusters of showy white, pinkish or bluish flowers after the leaves appear, and fleshy fruits (pomes). Horticulturally this is one of the most important of plant genera, since it includes the apple, pear, quince, and medlar (qq.v.). The last two, however, are often separated into distinct genera. Some of the species, as crab apples, are cultivated for ornament.

Pythagoras, pī-thăg'ō-ras, Greek philosopher: b. Samos about 582 B.C.; d. about 507. His father, Mnesarchos, was a merchant (probably of Tyre or some other Phœnician city) who traded with Samos, where he received the rights of citizenship, and settled with his family. The biography of Pythagoras is mingled with many fables. He received his first instruction from Creophilus in his native city. He then went to the island of Scyros, and was a scholar of Pherecydes till the death of the latter; others make him also a scholar of Thales and Anaximander. Iamblichus says that Pythagoras, during his journey to Egypt, spent some time in Phœnicia in intercourse with the successors of Moschus, and other priests of the country, by whom he was initiated into their mysteries, and that he traveled through various parts of Syria in order to become acquainted with the most important religious usages and doctrines. He is said to have been recommended by Polycrates, king of Samos, to the Egyptian king Amasis. In Egypt he became acquainted with the whole range of Egyptian learning. He remained in Memphis and Thebes 22 years, and was in Egypt when that country was conquered by Cambyses. Like many others of the sages in that kingdom, he was carried captive to Babylon, where he conversed with the Persian and Chaldean Magi; and traveled as far as India, and visited the Gymnosophists. After his return he opened a school at Samos, in which he taught his doctrines in a symbolic form, in imitation of the Egyptians. He also visited Crete, where the priests of Cybele took him to the caverns of Ida, in which Jupiter had been cradled. Here he met Epimenides, whom he initiated into the sacred mysteries of the Greeks. From Crete he went to Sparta and Elis, and from thence to Phlius, where, being asked by King Leon what was his profession, he replied that he was a philosopher (or lover of wisdom), declaring that the name of sage (*sophos*) belonged solely to the Divinity. With augmented knowledge he returned home, where he now founded a philosophical school with great success. He laid claim to supernatural powers, and his extraordinary qualities gained over great numbers of the noble and wealthy classes. Three hundred of these were formed into a select fraternity or order, which has been frequently compared with the still more famous order founded by Loyola in modern times. The members were bound by a vow to Pythagoras and each other, for the purpose of cultivating the religious rites and ascetic observances of their master, and of studying his system of philosophy. They thus formed at once a philosophical school and a re-

ligious order, which in time assumed the character and exercised the influence of a political association also. This influence, which became very considerable, was constantly exerted in the interest of the aristocratic party. The democratic party (perhaps, also, at times, an unfriendly aristocratic faction) reacted against the growing power of the order. At the head of this opposition party in Crotona was Cylon, a rich and respectable citizen, whose enmity Pythagoras had excited by refusing to receive him among his scholars. In revenge Cylon once attacked the house of Milo, where a number of Pythagoreans were assembled, surrounded it with his partisans, and set it on fire. Forty persons perished, and but few escaped. Pythagoras was probably not in the house. Other authorities set down this event long after the death of Pythagoras, who, they say, was simply banished by Cylon to Metapontum. He fled to the Locrians, and when these refused to receive him, to Metapontum, where, according to tradition, he perished from hunger. Consult: Lewes, 'Biographical History of Philosophy'; Grote, 'History of Greece'; Zeller, 'Pre-Socratic Schools.'

Pythagoras of Rhegium, rē'jī-ŭm, Greek sculptor: b. Samos toward the end of the 5th century before Christ. He was noted for his skill in giving the finest and justest proportions to his statues which often represented the human body in attitudes most difficult to represent. Such were his 'Limping Philoctetes' (in bronze); his 'Apollo in Combat with the Dragon'; his 'Duel of Eteocles and Polynices'; 'Europa and the Bull.' His favorite subjects were victors in the public games, and it was his habit as an artist to elaborate the details of his figures; he was learned as an anatomist and in his statues the hair, sinews, and even veins were represented with life-like distinctness and individuality.

Pythagore'an Theorem, the 47th proposition of the first book of Euclid's Elements, which shows that in any right-angled triangle the square on the hypotenuse is equal to the sum of the squares on the other two sides.

Pythagoreanism, the philosophical doctrine of the Pythagoreans, or followers of Pythagoras (q.v.). The system of the Pythagoreans was comprehensive and included a theory of being, that is, a metaphysic; a cosmological theory; and a mathematical theory.

Pythagorean Metaphysics.—The Pythagoreans taught that the essence of all things was number; that everything in its final analysis could be resolved into number. This statement, which is recorded in Aristotle's Metaphysics, where he is enumerating the Greek schools of philosophy, has occasioned much dispute. We may perhaps see in this doctrine the basis of the 10 antitheses of Pythagorean teaching, especially that of the opposites, odd and even, the definite and indefinite, which are placed first in the list. Number was also an idea in which these opposites were each included, and was therefore sometimes spoken of as harmony. But other interpretations of the Pythagorean number make unity and duality as the root notion, and pronounce that these terms may be reduced to the opposition of the spiritual and corporeal, of form and substance, of the Supreme Being and the material world. The Deity is the one,

MYTHICAL CAMLS

and he concluded that, on the basis of the information available, the Soviet Union had not been able to develop a nuclear weapons capability because the USSR had not been able to develop a nuclear weapons capability. The Soviet Union had not been able to develop a nuclear weapons capability because the USSR had not been able to develop a nuclear weapons capability.

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PYTHON (*Python molurus*)

PYTHEAS—PYTHIAN GAMES

the Original Unity, the Infinite, out of which all finite things have come. The opposition between the limited or finite, and the unlimited or infinite is by some philosophers regarded as the fundamental idea in the Pythagorean number. It is possible that the doctrine was from the first propounded as a vague generalization which might be and was interpreted in different ways by different members of the school. It is evident that nothing can exist without number, as is stated in the apocryphal Book of Wisdom, in some respects a product of Alexandrian Neo-Pythagoreanism. The numbers themselves are divisible into odd and even, and thus suggesting the contrast between the limited and unlimited, the conditioned and the unconditioned, the relative and the absolute, matter and spirit, man and God. On the other hand, it is possible that the Pythagorean number was not arithmetical but geometrical. The great disciple of Pythagoras in the time of Socrates was Philolaus, but of the writings in which he expounded his views only fragments survive, and these are of doubtful authenticity. Philolaus may have been under the influence of Democritus, and his theory of number have been based on geometrical axioms, and the intervals in the sounds struck from the seven-stringed lyre. Probably he was an atomist. The individual atom would in that case represent to him a material spatial point, two of which made a line, three a surface, four a solid; of these solids, represented always by even numbers, the constituents of earth were cubical; those of fire tetrahedral, those of water icosahedral, etc. From the use of numbers as the ontological basis of things the passage was easy enough to the wild and fanciful application of them as mere symbols. Thus the later Pythagoreans made the soul correspond with the number six, while seven was the counterpart of reason and health. The imagination here stepped in and with curious ingenuity labored to give a rational basis to these axioms. Hence the famous oppositions of this philosophical sect; namely (1) limited and unlimited; (2) even and odd; (3) one and many; (4) right and left; (5) male and female; (6) rest and motion; (7) straight and crooked; (8) light and darkness; (9) good and evil; (10) square and rectangle. It will be perceived that in these oppositions the idea of completeness, as represented by an even number, and incompleteness by an odd number is the ruling element, and in the idea of incompleteness is implied the potentiality of indefinite extension, multiplication, or variation.

Pythagorean Cosmology.—Pythagoras, or at least the Pythagoreans, had some vague idea of a heliocentric solar system. They taught that the universe had as its centre a fire round which the earth and stars revolved. This central fire was not identified with the sun; the stars were luminous from reflecting its light. They taught that this fire was not visible from the earth; that there was a counter earth which made up with the five known planets, the fixed stars, sun, and moon 10 celestial phenomena. The distance of the spheres from the central fire was determined according to simple numerical relationships. The harmony of the spheres was a melodious sound resulting from the revolution of the heavenly bodies in accordance with the intervals of their distance from the central fire. The Pythagoreans dis-

covered the connection between the length of the string in a lyre and the character of the note which was sounded on percussion. They taught the transmigration of souls.

Pythagorean Geometry.—The Ionic school of Greek philosophy imported geometry from Egypt into the Greek world of intellectual activity. Its early development in Europe was mainly due to the followers of Pythagoras, who himself enunciated the theorem now known as the 47th proposition of the first book of Euclid. The three proportions, arithmetical, geometrical, and harmonical were known to them and the so-called most perfect proportions, such as $6:8=9:12$, were familiar to them, having been introduced into Greece by Pythagoras who learned it from its inventors the Babylonians.

Pytheas, pîth'ê-as, Greek navigator: b. Massilia (Marseilles) in the 4th century B.C. He made two voyages of discovery along the western coast of Europe from Gibraltar to Iceland. The first voyage extended along the western coast of Europe, through the English Channel, and after somewhat extensive explorations in Britain he proceeded northward and reached Thule, which seems identical with Iceland. Here he was deterred from farther advance by dense fogs and considered himself to have reached the point where the earth ended. He described the fog as a molluscous substance, in which earth, air, and sea mingled and in which the universe was suspended. His second voyage seems to have extended along the coast of Denmark and to the Baltic. His accounts of his voyages were received as fables by the ancients, and, though celebrated as a navigator and mathematician, little is known of him excepting through the brief and adverse criticism of later writers, among whom are Strabo and Pliny. His accounts were without doubt in the main correct, but the loss of his works makes it difficult to ascertain his real status. He was said to have been the first to determine the sun's meridian altitude at Marseilles at the summer solstice by means of a gnomon. The scanty fragments remaining of his writings were published by Arvedson (1824).

Pyth'ian Games, in ancient Greece, a name given one of the four seasons of games, instituted in early times in honor of Apollo, the conqueror of the Python. They were celebrated in the neighborhood of Delphi (formerly called Pytho), in the Crissæan fields, which for this purpose contained a hippodrome or race-course; a stadium of 1,000 feet in length; and a theatre, in which the musical contests took place. According to the popular mythological legend the Pythian Games were instituted by Apollo himself. They seem to have been originally only a musical contest, which consisted in singing a hymn to the Pythian god. Until about 586 B.C. they were under the management of the Delphians, and took place at the end of every eighth year; but after that date they were conducted by the Amphictyons, and were celebrated at the end of every fourth year, and prizes were added for flute-playing, athletic sports, and horse and chariot racing. Eventually contests in tragedy and other kinds of poetry, painting, sculpture, and historical narratives were introduced. At first the prizes were silver or gold, but afterward they consisted of the laurel wreath and the symbolic palm-branch. The statues of





PYTHON (*Python molurus*)

PYTHIAS — PYXIE

the victors were erected in the Crissæan plain. They continued to be celebrated, it is believed, until the end of the 4th century.

Pythias, pîth'î-as. See DAMON AND PHINTIAS.

Pythias, Knights of. See KNIGHTS OF PYTHIAS.

Py'thon, a genus of serpents included in the family *Boidæ*, and the popular name for the same. They form a subfamily (*Pythonidæ*) distinguished from the true boas by having teeth in the premaxillary bone, a pair of supraorbital bones, and the ventral plates of the tail mostly in two rows. With one exception all the pythons belong to the Old World, while the boas occur in both hemispheres. These snakes may possess more than 400 vertebræ, and *P. reticulatus*, of the Malay Islands, and *P. molurus*, of India and Ceylon, may attain a length of 30 feet. A rudimentary pelvis and traces of hinder limbs exist in the pythons, these structures terminating externally in a kind of hooked claw, which, together with the short prehensile tail, adapt them to arboreal habits.

Although destitute of any venomous qualities, these snakes are greatly dreaded on account of their enormous strength. They suspend themselves from the branches of trees, generally in the neighborhood of water, and lie in wait ready to pounce upon animals which come to drink. The body is wound round the victim, which is crushed into a shapeless mass by the powerful constricting folds of the snake. Greatly exaggerated stories of the huge bulk which these serpents are able to swallow have been circulated, but no doubt a goat or sheep can readily be disposed of. The teeth of these serpents are simply conical recurved structures, which, while useless for mastication, will tend to fix and retain the prey in the mouth, and prevent its egress during the movements of swallowing. The jaws may, through the loose and disjointed arrangement of the squamosal and quadrate bones, be very widely separated from the skull, so as to largely increase the size of the mouth from above downward; while the halves of the lower jaw being but loosely connected by elastic ligaments, the cavity of the mouth can thus be greatly enlarged from side to side also. The throat is also exceedingly distensible, and from a consideration of the foregoing points it is easy to conceive how the bodies of even large animals may be slowly and gradually swallowed. The process of deglutition once begun

is largely mechanical. The snake neither sees nor tastes the object, and the mandibles work back and forth alternately to force it down the throat, and largely independently of the snake's will. Thus a number of cases are on record in which blankets, having become entangled in the teeth of large serpents, were reluctantly swallowed and caused their death.

Pythons lay numerous eggs, about which the female coils more to protect than to incubate them. This habit is frequently observed in zoological gardens. The African pythons rarely exceed 12 or 15 feet. Others occur in Australia. The only American representative of the subfamily is *Loxocemus bicolor*, of Mexico and Central America. Consult: Bumpus, 'Standard Natural History,' Vol. III. (Boston, 1885); Boulanger, 'Fauna of British India' (London, 1890). See BOA.

Pyx, anciently any casket and in particular a jewel-case. The present significations of the word are: (1) The vessel, of gold or silver-gilt, in which, in Catholic churches, the blessed sacrament is reserved; called also ciborium; and the small silver-gilt vessel in which the host is carried to the sick for administration at their homes. In former times the pyx had the form of a dove and was suspended above the altar; in present usage it is reserved in the tabernacle or shrine above the high altar. (2) The box or chest in which, at the English mint, specimens of the coinage are deposited, to be tested by a jury of goldsmiths about once in three years; this test is called the "trial of the pyx."

Pyxie. The pyxie, or flowering moss (*Pyxidanthera barbulata*), is one of the most beautiful and early-flowering plants of the moist, sandy, pine-barren regions of New Jersey and North Carolina. It is found only in certain localities even in this restricted district, but is abundant in its chosen haunts, blooming in April. The pyxie belongs to the *Diapensia* family, very closely related to the heather tribe, and is a small, evergreen, shrubby plant, lying, cushion-like, flat on the sand, and having long, tapering branches trailing in all directions. The small, rigid, pointed leaves are tinged with red at blossoming time, and are very numerous, but are nearly hidden by the profusion of waxen, symmetrical, five-lobed flowers, coral-tinted in the bud, creamy white when open. The twin anther-cells of the five anthers are globose and transversely valved, whence the Greek generic name, meaning box-anther.

Q

Q the seventeenth letter of the English, Latin and other alphabets of western Europe. As in Latin so in English it is always followed by the vowel *u*: as in English so probably in ancient Latin *qu* was equal to *cu* or *kw*: *q* is therefore a superfluous letter and has no place in a scientific alphabet, save as standing for some sound differing from that of *k*: in A. J. Ellis's palæotype alphabet *q* stands for nasal *ng*. Some of the ancient Latin grammarians regarded *Q* as a contracted form of *CV* (that is *cu*); but others, and with them modern philologists recognize in *Q* a modified form of the koppa of early Greek *Q*, derived from the Phœnician alphabet. This character occurs in very ancient Latin inscriptions; but later the down stroke was written aslant, *Q*, whence the form *Q*. *Q* was not employed in Anglo-Saxon writing, *cu* being used instead: *cwēn*, queen; *cwellan*, to quell; nor was it used in early Teutonic writing, except for words borrowed from Latin; but afterward words of native Germanic origin were spelled with *q*: *quālen*, to torment; *quer*, athwart.

Qua (kwā) Bird. See HERON.

Quackenbos, kwāk'ēn-bōs, **George Payn**, American educator: b. New York 4 Sept. 1826; d. New London, N. H., 24 July 1881. He was graduated at Columbia in 1843 and admitted to the bar. Later he abandoned law and for many years conducted a large private school in New York. He published: 'Advanced Course of Rhetoric and Composition' (1854); 'School History of the United States' (1857); 'Natural Philosophy' (1859); and many other once popular text-books.

Quackenbos, John Duncan, American physician: son of G. P. Quackenbos (q.v.): b. New York 22 April 1848. He was graduated from Columbia in 1866 and from the College of Physicians and Surgeons in 1871, and has since practised in New York. He became adjunct professor of English at Columbia in 1884, and was professor of rhetoric in Barnard College 1891-3. He is a specialist in mental diseases and has published among various other works, 'History of the World'; 'History of Ancient Literature'; 'Tuberculosis'; 'Typhoid Fever'; 'New England Roads and Roadside Attractions'; 'Hypnotism in Mental and Moral Culture.'

Quackenbush, kwāk'ēn būsh, **Stephen Platt**, American naval officer: b. Albany, N. Y., 23 Jan. 1823; d. Washington, D. C., 4 Feb. 1890. He entered the navy as midshipman in 1840, received rank as lieutenant in 1855 and

lieutenant-commander in 1862. In the early part of the Civil War he had charge of the Delaware, Unadilla, Pequot, Patapsco, and Mingo in the blockading squadron, covered Gen. Burnside's army at Aquia Creek and Roanoke Island, participated in the battles at Elizabeth City and New Berne, N. C., engaged the Confederate batteries at Winton, N. C., and destroyed the town. He later took part in the engagements at Sewell's Point landing, Wilcox landing, and Malvern Hill, and received at the last mentioned place a wound from which he lost his right leg. In 1863 he captured the Princess Royal loaded with materials for a Confederate ironclad. In 1864 while dredging Charleston harbor for torpedoes his ship, the Patapsco, was struck by a torpedo and sunk. Later he was in command of the Mingo, protecting Georgetown, S. C. He became rear-admiral in 1884 and was retired in 1885.

Quadi, kwā'di, an ancient powerful people of southeastern Germany, of the Suevic race. They inhabited the country bounded by Mount Gabreta, the Hercynian forest, the Sarmatian mountains, and the Danube; their neighbors being the Gothini and Osi on the north, the Jazyges Metanastæ on the east, the Pannonians on the south, and the Marcomanni on the west. With the last named people they were on terms of alliance. In the reign of Tiberius the Romans erected a kingdom of the Quadi; but in the reign of Marcus Aurelius the Quadi joined the great German confederacy against the empire, and in 174 were on the point of destroying the imperial legions in a great battle when a sudden storm, attributed to the prayers of the Christian soldiers in the emperor's army, enabled the Romans to recover from their confusion and achieve a complete victory. The independence of the Quadi was recognized by Commodus in 180. They disappear from history about the close of the 4th century.

Quadrages'ima, the period of the 40 days' fast preceding Easter: the season has a like name in Greek, *Tesserakostē*, fortieth. The first Sunday of Lent is sometimes called *Quadragesima*, but in the Roman calendar it is *Dominica prima Quadragesimæ*, first Sunday of Lent: and the Sundays following are denominated respectively, the second, third, and fourth of Quadragesima, Passion Sunday (*Dominica Passionis*), and Palm Sunday (*Dominica Palmarum*). In the Book of Common Prayer these six Sundays are called the first, second, third, fourth, and fifth of Lent and "Sunday next before Easter"; but this Sunday is also styled in England and the United States "Passion Sunday," and its week "Passion Week"; its familiar name among Catholics is "Holy Week."

QUADRANGLE—QUADRATURE OF THE CIRCLE

Quad'rangle, a square or four-sided court or space surrounded by buildings, as often seen in the buildings of a college. Also in geometry, a figure having four angles, and consequently four sides.

Quadrant. See SURVEYING.

Quadrant Electrometer, in electricity, an instrument constructed by Sir William Thomson (Lord Kelvin) to measure with great accuracy small charges of electricity. See ELECTROMETER.

Quadrate Bone, the squarish bone developed in reptiles and birds, by means of which the lower jaw is articulated or joined to the skull. The lower jaw of these forms is thus not articulated directly or of itself to the skull, as in mammals; and in reptiles and birds each half of the lower jaw is composed of a number of distinct pieces. In mammals, on the contrary, the lower jaw consists simply of two halves united together in front. The *os quadratum*, or quadrate bone, which thus forms a characteristic structure of birds and reptiles, is generally regarded as corresponding in mammals to one of the little bones or auditory ossicles of the internal ear, named the malleus. See EAR.

Quad'rature of the Circle. The problem involved in the quadrature of the circle requires the determination of the length of a straight line such that the square constructed thereon shall have an area equal to that of a given circle. It can be shown in a variety of ways that, if r is the radius of the circle, the area will be equal to πr^2 where π can only be obtained approximately in terms of a finite number of fractions. On the other hand, it has become a matter of general information that the quadrature of the circle is impossible, and this is true only when the ancient Greek problem is understood, which involves a serious limitation; that is, the quadrature must be effected by means of a geometrical construction in which the mathematician is limited to the use of but two instruments, the straight edge and a pair of compasses. The problem is not solved, therefore, if any other instrument or any equivalent analytic method is employed. For four thousand years innumerable attempts have been made to discover this construction, all destined to fail, as it was demonstrated by Lindemann in 1882 to be impossible. In reaching this conclusion we are confronted by the fundamental question: What geometrical constructions are, and what are not, possible, when restricted to the use of these instruments? In analysis, operations correspond to constructions. The operation, $a \times b$, involves taking b units a times, which, with an assumed unit of length, is equivalent to laying off a line having $a \times b$ units of length, which is accomplished by using the method of proportions. In a similar manner, the *rational* operations of addition, subtraction, multiplication, and division find a geometrical solution involving the straight edge alone.

Irrational operations are divided into algebraic and transcendental. Any operation that involves the extraction of a square root only presents the simplest case of an algebraic irrationality, and any construction involving the determination of the points of intersection of two circles, or a circle and straight line, leads to

an equation of the second, of the fourth, or of some higher degree, whose solution involves the extraction of square roots and rational operations only. Conversely, the necessary and sufficient condition that unknown quantities can be constructed with the straight edge and compasses is that the unknown quantities can be expressed explicitly in terms of the known by an analytic expression involving only a finite number of rational operations and square roots. In other words a Euclidean geometrical solution is impossible when no corresponding algebraic equation exists. When a number like $\sqrt{2}$ is the root of an algebraic equation with integral coefficients, for example, $x^2 - 2 = 0$, and still can not be expressed exactly in terms of a finite series of numbers it is an algebraic irrational number. When the number, like e , the natural base in the theory of logarithms, or π , the ratio of the circumference to the diameter, is not the root of any algebraic equation, with integral coefficients, it is a transcendental number. Lindemann proved that π is a transcendental number and, hence, since it is not the root of any algebraic equation, it can not be constructed to an assumed unit by the extraction of square roots, that is by using the straight edge and compasses.

The possibility of a geometrical solution in general depends upon a theorem in the theory of numbers to the effect that *the degree of the irreducible equation satisfied by an expression composed of square roots only is always a power of 2*; whence, conversely, *if an irreducible equation is not of degree 2^n , it cannot be solved by square roots*.

Next to the squaring of the circle, the most famous problems of antiquity are the *Delian problem* or the *duplication of the cube* and the *trisection of an arbitrary angle*. Granting the preceding general theorem, these are easily shown to be impossible when restricted to the straight edge and compasses.

The duplication of the cube requires the determination of the edge of a cube x , such that its cube shall be twice the volume of a given unit. That is $x^3 = 2$. This equation is irreducible, since otherwise $\sqrt[3]{2}$ would be rational. Moreover, the equation is a cubic and its degree is not of the form 2^n . Hence the solution is in general impossible.

The problem of the trisection of an arbitrary angle corresponds to the solution of

$$x^3 = \cos \phi + \sqrt{-1} \sin \phi,$$

and it follows that in general this is impossible by Euclidean methods.

History.—The quadrature of the circle is attempted in the Rhind Papyrus (2000 B.C.), the oldest known mathematical work, in which Ahmes, an Egyptian priest, lays down the empirical rule: "Cut off one ninth of the diameter; the square on the remainder will equal the area of the circle." This rule affords $\pi = (\frac{25}{8})^2 = 3.16$, a value reasonably accurate as compared with $\pi = 3$, the value assumed in the Bible (1 Kings vii. 23, Chronicles iv. 2). Archimedes (200 B.C.) invented the method still used by students of plane geometry that depends on inscribing and circumscribing regular polygons, which, save for an improvement by Huygens (1654), remained in use until the invention of the calculus of Newton and Leibnitz (1670-

1770). Hippocrates of Chios (470 B.C.) was the first to investigate areas bounded by curves and to bring into prominence the problems of squaring the circle and duplication of the cube. According to Philoponus, the Athenians were suffering from a severe plague of typhoid fever in 430 B.C., and were told by the oracle at Delos that Apollo required an altar in the form of a cube twice the size of the one existing. A new one was therefore constructed, having each edge twice the length of the old one, but the plague was worse than ever. Suspecting some mystery, confirmed by the insistence of the oracle, the Greeks applied to Plato, the most illustrious of their geometers, and were referred by him to Hippocrates. He succeeded in reducing the problem to the determination of two mean proportionals: for, if $a : x = x : y = y : 2a$, then $x^3 = ay$ and $y^3 = 2ax$, the equations of two parabolas, which intersect in a point whose abscissa is $x^3 = 2a^3$. This is equivalent to a graphical solution by means of conics, but to draw the curves, a different instrument would be required than those prescribed by Euclid. The problem was thereafter known as the Delian problem. The *Cissoïd of Diocles* (150 B.C.) and the *Conchoid of Nicomedes* (150 B.C.) are curves of the third and fourth degree respectively, invented for the special purpose of duplicating the cube and trisecting any angle. The curve known as the *quadratrix of Dinostratus* (350 B.C.) which, however, had previously been constructed by Hippias of Elis (420 B.C.) for the trisection of the angle, sufficed also to determine the length of a circular arc and for the quadrature of the circle. It belongs to the class known in modern times as *integral curves*, since the ordinate can be expressed as an integral, such a curve being known to the ancients as a *quadratrix*. If OA and OB are two perpendicular radii of a circle and two points M and L move with constant velocity one upon the radius OB and the other upon arc AB, such that starting from O and A at the same time they both arrive simultaneously at B; then the intersection of OL and MP drawn parallel to OA is a point on the quadratrix. The ordinate, y , is proportional to θ , the angle between

OL and OA, and since $y = 1$, when $\theta = \frac{\pi}{2}$, $\theta = \frac{\pi}{2} \cdot \frac{y}{1}$.

But $\theta = \tan^{-1} \frac{y}{x}$, the equation of the quadratrix becomes $\frac{y}{x} = \tan^{-1} \frac{\pi}{2} y$.

It cuts the axes of X at the point whose abscissa is $x = \lim_{y \rightarrow 0} \frac{y}{\tan \frac{\pi}{2} y} = \frac{2}{\pi}$.

It follows that the radius of the circle is the mean proportional between the length of the quadrant and the abscissa of the intersection of the curve with the axis of X. Hence any apparatus that will describe the quadratrix will enable us to determine π graphically. Evidently the curve $y = \sin^{-1} x$ is much more convenient for this purpose, since π is one of the ordinates of this curve when x equals zero; but this curve does not appear to have been used by the Greeks. It is called the *sinusoid*, the axes being vertical,

and any transcendental apparatus which will trace the sinusoid by continuous motion would afford a geometrical construction of π . Such an apparatus has been invented recently by a Russian engineer, Abdank Abakanowicz, and constructed by Coradi of Zürich. It is called the integrator, and with its aid it is possible not only to lay off π but to trace the *integral curve*.

$Y = F(x) = \int f(x) dx$, when the differential curve $y = f(x)$ is given.

The rise of modern analysis after Newton and Leibnitz developed many new methods for the evolution of π , the best known being the so-called series of Leibnitz,

$$\pi = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

After the invention of logarithms by Napier (1614), Euler, by the introduction of complex quantities, developed the celebrated relation between the Napierian base e and π ,

$$e^{ix} = \cos x + i \sin x$$

which for $x = \pi$ reduces to the most remarkable relation in mathematics,

$$e^{i\pi} = -1.$$

The modern proof of the transcendence of π is based upon this relation, since they all depend upon that of e . In 1873 Hermite ('Sur la Fonction exponentielle,' *Comptes rendus*, 1873) first proved the transcendence of e , and this was followed, in 1882, by an analogous demonstration for π , given by Lindemann ('Über die Zahl π ,' *Mathematische Annalen*, XX. 1882). This demonstration is equivalent to proving that the Euclidean problem of the quadrature of the circle is impossible, and closes in this generation a question that has occupied mathematicians for 4,000 years. The long and difficult proofs of Hermite and Lindemann have been much simplified, first by Weierstrass (*Berliner Berichte*, 1885), and in particular by Hilbert, Hurwitz, and Gordon (*Mathematische Annalen*, Vol. XLIII.). The questions involved treated without requiring a knowledge of the calculus have become familiar to English mathematicians through the translation by Beman and Smith of Klein's 'Famous Problems of Elementary Geometry' (1897).

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Quadriennium Utile, kwäd-rî-ën'î-üm ü-tî-lä (Latin, meaning "four years useful"), a phrase in Scotch law, referring to the four years after majority, during which period, a person may set aside or revoke any deed executed during his minority, if such deed is to his prejudice. The same law existed among the Romans, to protect the rights of minors by giving them, after majority, an opportunity to revoke any deed which had been made to their disadvantage, when they were inexperienced minors or, in the eyes of the law, infants.

Quadri'ga. See CHARIOT.

Quadrilat'eral, a common name for the four fortresses of North Italy: Mantua, Legnago, Peschiera, and Verona, which form an outwork to the bastion of the mountains of the Tyrol. They have figured prominently in the

QUADRILATERAL — QUAGLIO

was between Austria and the different Italian states.

Russia has a combination of four fortresses in Poland, which are called the Polish Quadrilateral.

Quadrilateral. See POLYGON.

Quadrille, kwăd-rîl', or kă-drîl', (1) a dance of French origin, but now popular in most civilized countries of the globe, and which consists generally of five consecutive figures or dance movements, danced by four couples, each forming the side of a square; or by four sets (often pairs) of couples. (2) Also an obsolete game of cards played by four persons. The game is celebrated by Pope in "The Rape of the Lock."

Quadriscramentarian, or **Quadriscramentalist**, a term of theological polemic applied by Melancthon and the Lutherans to certain of the Reformers in Wittenberg and its vicinity who maintained the divine institution and necessity for salvation of four sacraments (Latin, *quadri*=*quatuor*, four, *sacramentum*, sacrament), namely, in addition to the two approved by Luther, Baptism and the Eucharist, other two, namely, Confession (or Absolution, or Penance) and Order.

Quadrivium, the name given in the Middle Ages to the four mathematical branches of study, arithmetic, music, geometry, and astronomy, in contradistinction to the Trivium, which consisted of the three remaining branches taught in the mediæval schools, and which consisted of grammar, rhetoric, and dialectics, the whole comprehending what was called the seven liberal arts.

Quadroon, or **Quarteroon**, a person of mixed blood, usually one who is one quarter negro and three quarters white; that is, one of whose grandparents was white and the other negro; and one of whose immediate parents was white and the other mulatto.

Quadrumana, the name applied by Cuvier and others to denote the order of "four-handed" mammalia represented by the lemurs, monkeys, and apes, from the fact that these forms agree in possessing a great toe so constructed as to be capable of opposing the other digits of the feet, instead of being placed parallel with the other toes, thus forming a kind of "hand" adapted for supporting the foot on the ground. Cuvier separated man as a collateral order *Bimana* or "two-handed" mammalia. But in modern zoology, man is included in one order with the apes and monkeys — the order *Primates* (q.v.).

Quadruple Alliance, a union of four sovereigns or states to forward their common policies. Notable among such unions was the alliance between Great Britain, France, and the German Empire, concluded at London in 1718, in which Holland joined 1719: its objects were to secure to the house of Hanover the succession to the British crown; to secure France to the house of Bourbon; and to prevent the union of France and Spain under one crown. Another memorable quadruple alliance was that of Austria, Russia, Great Britain, and Prussia, formed in 1814 to regulate the political system of Europe after the fall of Napoleon. And in 1834 England, France, Spain, and Portugal entered into

an alliance to put down Don Carlos and his partisans.

Quæstor, kwēs'tôr, the title of a class of magistrates in ancient Rome who had charge of the pecuniary affairs of the commonwealth: they were the treasurers of state. Of these one, *quæstor urbanus* or *q. æarii* (urban quæstor, quæstor of the treasury), who remained at Rome, administered the public revenues and expenditures. Other quæstors, called provincial or military quæstors, served as assistants to the proconsuls or proprætors who governed the several provinces: their duty was to provide for the payment and provisioning of the troops, to collect the imposts, and, in the absence of the governor, to act in his stead. In very early times there was in Rome an official styled *quæstor parricidii* (tracker of murder) who prosecuted persons charged with capital offenses. A quæstor was *ex officio* entitled to a seat in the senate.

Quagga, kwäg'a, a species of the horse (*Equus quagga*), nearly allied to the zebras, formerly found on the plains of southern Africa, but now quite extinct. It was striped like the zebra, but did not possess bands on the limbs. The color was dark brown on the head, neck, and shoulders, the back and hind quarters being lighter, while the croup was russet gray. The under parts of the body were white, the upper parts of the legs and tail being marked by whitish bars. The quagga was smaller than the zebra, and bore a closer resemblance to the horse. The ears were short, the head being relatively small. The tail was tufted. These animals were gregarious, the herds which inhabited the Kaffrarian plains numbering each several hundreds of individuals, which would mingle with the zebra herds. The quagga was active, nimble, and elegant in its movements. The Bushmen and Kaffirs esteemed the flesh as good palatable food, and these animals were on the same account unremittently pursued by the lion. It was tamed without much difficulty, but domestication apparently altered its disposition and rendered it dull and less active in habits. The Dutch colonists were said to be in the habit of keeping quaggas along with their cattle; and the quaggas defended the cattle from the attack of hyænas and other carnivora, by trampling on the invaders and otherwise injuring them. The quagga bred with the common horse; and a mixed race of this kind, possessing great beauty of form, and retaining in a great degree the characteristic markings of the quagga, is said to have existed in England at one time. The name "quagga" was derived from the cry of the animal, which may most nearly be expressed by the word *Coua-ag*. The animal has received a variety of names from authors: thus Pennant terms it the *quacha*, and Masson the *opeagha*. Consult: Bryden, "Nature and Sport in South Africa" (1897), and early writers on South Africa, especially Harris, Lichtenstein, and Gordon-Cumming.

Quaglio, kwă'lē-ō, name of a family of painters, originally belonging to Laino, Lago Maggiore, Italy, but afterward dwellers in Munich. The most eminent among them, Domenico (b. Munich 1 Jan. 1786; d. Hohenschwangau 9 April 1837), was for 11 years decorative painter for the Munich Theatre. He subsequently

QUAHA—QUAIL

turned his attention to oil-painting and also executed etchings and lithographs. He traveled through Germany, along the Rhine, to the Netherlands, to France, Switzerland, and Italy, with the object of studying mediæval architecture as a subject for painting. During the latter period of his life he was engaged by the Crown Prince Maximilian of Bavaria in the restoration and decoration of the castle of Hohenschwangau. He was member of the Academy of Munich and Berlin and one of the first German artists to produce in painting architectural effects of a thoroughly artistic quality. He also published books on the mediæval buildings of Bavaria; on the most noteworthy buildings of Munich; and on the architectural statuary of Bavarian mediæval buildings. His brother, LORENZ QUAGLIO (b. Munich 19 Dec. 1793; d. there 15 March 1869), directed his studies to genre painting and lithography. In this latter department of art he reached the highest excellence. His paintings consist of incidents from mediæval life, and his landscapes are taken from the highlands of Bavaria. The third brother, SIMON QUAGLIO (b. Munich 23 Oct. 1795; d. there 8 March 1878), was scene painter and decorator to the Hof Theatre and executed many exceedingly clever pictures in oil, chiefly of architectural subjects and distinguished for faultless perspective, beauty of design, and brilliancy of coloring. ANGELO, son of the last (b. Munich 13 Dec. 1829; d. there 5 Jan. 1890), was scene painter to the Bavarian Hof Theatre, and by his architectural decorations gained a world-wide reputation.

Quaha, the side-striped African jackal (*Canis lateralis*). See JACKAL.

Quahog, or **Round Clam**. See CLAM.

Quai D'Orsay, *kā dōr-sā*. See PARIS.

Quail, one of several partridges (q.v.); in the eastern United States the bob-white (*Colinus virginianus*), and on the Pacific coast partridges of other genera. The eastern bob-white requires no description beyond a statement of the differences between the sexes. Besides being larger, the male has the superciliary line and throat pure white, these parts being buff and without black borders in the female which also has the colors generally more blended. The bob-white is widely distributed throughout the eastern United States; on the Atlantic coast it barely enters Maine, farther west it is found northward in New York, Ontario, and Minnesota; southward it is abundant in the Gulf and South Atlantic States, and westward reaches to the elevated central plains from South Dakota to Texas. Farther westward at many points in this country, in Jamaica, and other West Indian islands this species has been very successfully introduced, but similar attempts in Europe seem to have failed. The Florida and Texan birds present extremes of variation which are considered worthy of recognition as sub-species, and a related species of *Colinus* (*C. ridgwayi*) occurs in Arizona. Although in New England and elsewhere called "quail," and in the Middle and Southern States very generally "partridge," neither of these names is, properly speaking, correct. The bob-white of the farmer's boy is a far more characteristic and appropriate name. Like related species it is gregarious, but the coveys consist of members of one family—a pair of

old birds and their numerous progeny of one or two broods—which remain in company until the next pairing season. They live on partially open land where thickets, woodland borders, or fence rows offer suitable cover. Throughout most of the year they feed upon berries, seeds, and mast, but also frequent the grain-fields, especially after harvest, to glean the fallen seeds. Occasionally they attack fields of buckwheat, of which they are very fond, but the slight damage thus done is repaid many fold in the destruction of grasshoppers and other insects in the late summer and autumn. Most of their life is spent on the ground, on which they scratch like hens. When whistling or sometimes when alarmed they will perch upon trees or fences, but under the latter circumstances they usually run to a cover, where they remain perfectly motionless, or spring suddenly into the air with a loud whirr and fly swiftly straight away to a thicket. At night they commonly huddle together in a close bunch with heads outward in the concealment of a bush, but may occasionally roost on trees. The call is a clear loud whistle of two or three notes, variously interpreted as bob-white, and ah, bob-white; buckwheat and no buckwheat; or more wet, and no more wet, according to the point of view of the listener; the last has reference to the bird's supposed gift of meteorological prophecy.

Being non-migratory, the bob-white is frequently exposed to privation during the winter. During a heavy snow-storm the members of a covey will often huddle together to keep warm and allow themselves to become completely covered. Under ordinary circumstances they find their way out without difficulty, but should a crust form on the surface many will sometimes perish miserably from hunger, cold, and lack of air. In April and May they construct simple nests of coarse grass stems, usually arched over at the top, in a depression on the ground under the shelter of a bush or tuft of grass. The eggs are pure white and top-shaped. Numerous eggs—from 16 to 32—are found in each nest, and are very neatly arranged with the pointed ends downward. Whether they are the product of one or of several females is a matter of dispute, but certain it is the bob-white is typically monogamous, though occasionally he may take two wives. The young run immediately after hatching, and are wonderfully interesting and pretty creatures with a marvelous skill for concealing themselves when alarmed. Sometimes a second brood is raised in August. When this is the case the male takes sole charge of the first until the second is hatched, when both parents join the combined broods; thus are formed the largest coveys.

The bob-white combines all of those qualities which a sportsman seeks in an ideal game bird and it is, without question, the most sought and most generally appreciated by gunners of any game bird in this country. Every condition unites to make the sport exhilarating and healthful, to test the skill of the sportsman, and to please his appetite at the close of his labors. In most States this perfect game bird is now rigidly protected by laws prohibiting snaring, netting, and trapping, by the enactment of a close season covering the breeding period and continuing until the young birds are strong of wing, by prohibiting, under penalty of a heavy fine,

QUAIN — QUANTIFICATION OF THE PREDICATE

the shipment of birds outside of the State's jurisdiction, by requiring the payment of a license fee by non-resident shooters, or by other measures designed to meet local conditions or abuses. Although the bird is so prolific it has numerous natural enemies, especially hawks, weasels, skunks, cats, etc., which check its increase. When to this natural loss is added the enormous number annually sacrificed to the deservedly popular sport of quail-shooting, the necessity of legal protection becomes manifest. The nature and method of the sport differs so much with the varied actions of the birds due to season, locality, character of ground, etc., and to the local and personal idiosyncrasies of gunners, that the reader must be referred to some of the numerous sporting books for details. The general method is to hunt singly or in couples, with one or two dogs, which quarter the ground under the guidance of signs and whistled signals from the sportsman. When the birds flush they spring up suddenly and immediately attain full speed, which keeps the gunners always on the *qui vive*. Either pointer or setters may be used according to the character of the ground and the personal preference of the sportsman. By many the Llewellyn setter is considered to be the most perfect dog for rapid quartering of the ground and general adaptation to this class of sport. As to guns tastes differ; but a first-class, hammerless arm of moderate weight, long range, and 12 or 14 bore has the preference of experts. Smokeless powder is highly recommended.

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University of Pennsylvania.

Quain, kwān, Jones, English physician: b. Mallow, Ireland, 1796; d. London 27 Jan. 1865. He studied medicine at Dublin and Paris, and was professor of anatomy and physiology at London University 1831-6. He was the author of Quain's 'Elements of Anatomy' (1828, 10th ed. 1890); and published also a series of 'Anatomical Plates' (1858), and a translation of Martinet's 'Pathology' (1835).

Quain, Richard, English anatomist, brother of J. Quain (q.v.): b. Fermoy, Ireland, July 1800; d. London 14 Sept. 1887. He was appointed professor of anatomy and clinical surgery in University College, London, in 1837, and was elected president of the Royal College of Surgeons in 1868. Among his works are: 'Anatomy of Arteries,' with folio plates (1845); 'Diseases of the Rectum' (1854); 'Observations on Medical Education' (1865); 'Some Defects of Medical Education' (1870). He bequeathed nearly \$375,000 to University College, London, for the "education in modern languages (especially English) and in natural science."

Quain, Sir Richard, English physician, cousin of J. and R. Quain (q.v.): b. Mallow, County Cork, 30 Oct. 1816; d. London 13 March 1898. He studied medicine in University College, London, whence he was graduated in 1842. He was elected a member of the Royal College of Physicians in 1846; in 1871 was chosen a fellow of the Royal Society, and he was president of the General Medical Council from 1891 till his death. His practice in London was large and lucrative, and besides publishing several medical treatises he edited a well-

known 'Dictionary of Medicine' (1882; new ed. 1894).

Quaker City, a popular nickname applied to Philadelphia, which was planned and colonized by William Penn and other members of the Society of Friends.

Quaker Hill, Battle of, in the American Revolution, a notable battle fought 29 Aug. 1778. On the previous night, the 28th, the Americans on Rhode Island fell back toward Butts Hill at the northern end of the island. Contrary to Greene's advice the enemy were allowed to occupy Quaker and Turkey Hills. From these hills the British assailed the Americans, but were repulsed and driven back to Turkey Hill. The hottest of the battle took place on the low ground between the hills. The American loss in killed and wounded was 206; that of the British 222.

Quaker Ladies, or Quaker Bonnets. See HOUSTONIA.

Quaker Poet, The, a name often applied to John Greenleaf Whittier, and long before his day bestowed upon the English poet, Bernard Barton (q.v.).

Quakers. See FRIENDS, RELIGIOUS SOCIETY OF.

Quality, in the language of logicians, is used to designate the nature of propositions as affirmative or negative: the proposition "gold is a yellow substance" is of affirmative quality; "gold is not easily fusible" is a proposition of negative quality. In metaphysics quality is either primary or secondary: primary qualities are those which are essential to the existence, or even the conception, of the thing; secondary qualities are those not essential to such conception: whether primary or secondary, a Quality is that which makes, or helps to make, anything such as it is.

Quana, Comanche chief: b. about 1845. He is the most influential chief among the three confederated tribes of Kiowa, Comanche, and Apache in southwestern Oklahoma, and is a half-breed, his mother being a white captive married to a Kwahadi chief. Quana became prominent in 1874, when he acted as leader of the band of 700 picked warriors from the confederated tribes in an attack on the South Canadian River fort, Adobe Walls. He was active in the Indian uprisings of the following year, and was the last to surrender when peace was ultimately made. His superior intelligence, however, induced him to acquire white habits and customs, and after some time spent in Texas he became thoroughly convinced of the benefits of civilized life and on his return to his tribe endeavored to persuade them to adopt his views. In 1882 he proposed leasing the surplus pasture lands of the reservation, a measure which increased the income of the tribes by \$100,000 yearly. In 1888 he was appointed a judge of the Indian court, and in 1892 was the first signer of the treaty which opened the reservation lands to settlers in 1901.

Quantification of the Predicate, supplying to the predicate in a logical proposition a word, as "some," or "all," or "no," etc., to indicate whether the whole of it or only a part agrees with or differs from the subject. In the proposition "all metals are elements" the subject "metals" is quantified by the use of "all";

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but the predicate is not quantified, and in form the proposition does not distinctly assert whether metals constitute the whole list of elements or not. But by inserting "some" before the predicate, "elements" is quantified—"all metals are some elements." It was assumed by Aristotle and was maintained by all logicians after him till Ploucquet and Lambert in the 18th century and Sir William Hamilton in the 19th, that the predicate of all affirmative propositions is "undistributed" (not taken in its universal comprehension), while the predicate of a negative proposition is always distributed. But, after Sir William Hamilton had given notoriety to the doctrine of quantification, this was seen to be an error, through which an infinite number of affirmative propositions which are universal in both terms are excluded from the system of formal logic. Among the numerous changes in the theory of formal logic which follow from the adoption of the quantified predicate the most important are the reduction of the conversion of propositions from three species to one, reduction of all the general laws of categorical syllogisms to a single canon, and the abrogation of all the special laws of syllogism. But the doctrine of the quantification of the predicate has never been generally adopted in the exposition of formal logic, on the ground that there is no proposition that cannot be dealt with under the Aristotelian forms, and that quantification does not really simplify the theory of logic.

Quantity, in the language of *Mathematics*, is whatever can be increased or diminished or measured: space, time, weight, number, force, etc., are quantities. Quantities are represented in mathematics by symbols, and these too are called quantities. In algebra quantities are distinguished as known and unknown, real and imaginary, constant and variable, rational and irrational: a real quantity is one not involving an impossible operation; variable quantities are those which admit an infinite number of values in the same expression; rational, those which do not involve any radicals. A simple quantity is expressed by a single term, as a or b ; a compound quantity is one expressed by two or more terms connected by the sign of plus (+) or minus (—). Quantities having the plus sign prefixed are called positive or affirmative: those with the minus sign prefixed are called negative quantities. Similar quantities are such as consist of the same letters, and the same powers of the letters, as abc , $-2abc$, $+4abc$, etc. In *Logic*, quantity is the extent to which the predicate in a proposition is asserted of the subject: when the predicate is affirmed of the whole of the subject the proposition is a universal one, as in the example "all metals are elements": but when the predicate is affirmed only of a part of the subject, as in "some metals are brittle," the proposition is called a particular one. In *Grammar* and *Prosody*, quantity is the measure of a syllable, or the time in which it is pronounced. In *Music*, quantity is the relative duration of a tone.

Quantivalence. See **VALENCY**.

Quan'trell, William, American guerrilla: d. Kentucky, 1864. His depredations first became widely known when he raided Lawrence, Kan., destroying 185 buildings, killing 140 inhabitants and leaving the town completely

devastated. His operations were then continued through western Missouri and eastern Kansas, but upon his extending his ravages to Kentucky in 1864 he was outwitted and killed.

Quan'za, a river of Africa. See **KWANZA**.

Quapaw (kwā'pā) Indians. See **SIOUAN**.

Quarantine, a stated period (formerly 40 days) during which a ship coming from a port suspected of contagion, or having a contagious sickness on board, is forbidden intercourse with the place at which it arrives. Quarantine was first introduced at Venice in the 14th century. It is now required to be performed in almost every important country except Great Britain. In the United States quarantine enactments were passed by the colonial legislatures and afterward for many years by the States. The first national quarantine act was passed 23 Feb. 1799, requiring Federal officers to aid in the execution of State or municipal quarantine regulations. On 29 April 1878, a national quarantine act was passed. On 3 March 1883, \$100,000 was appropriated for maintaining quarantine points along the coast. On 1 Sept. 1892, owing to the presence of cholera, President Harrison proclaimed a 20 days' quarantine of New York. By law it is made a misdemeanor punishable by fine or imprisonment, or both, for the master, pilot, or owner of any vessel entering a port of the United States in violation of the act, or regulations framed under it. During the period of quarantine, all the goods, clothing, etc., that might be supposed capable of retaining infection, are subjected to a process of disinfection, which is a most important part of the quarantine system.

From 7 Nov. 1896, the system of quarantine ceased to exist in Great Britain, so far as regards the British Islands. The Quarantine Act of 1825 required that quarantine should be performed by vessels coming to the British Islands from places from which "the plague or other infectious disease or distemper highly dangerous to the health of his Majesty's subjects" might be brought; but in recent years this act has applied only to the plague and yellow fever, and has not often been used. Vessels arriving from infected places or carrying goods, etc., from such places, were required to be kept at some safe distance from the shore and from other ships—all their passengers and crew being detained on board—till all danger of spreading infection was considered to have passed. Healthy persons were thus exposed to the risk of taking any disease there might be on the ship.

In some places quarantine establishments were maintained for receiving persons from suspected vessels, but most of these were long since abolished, and latterly the only such receiving ships were some old hulks at the Motherbank in the Solent. These were maintained by the Privy Council, on whom devolved the administration of the Quarantine Acts. Orders in Council prescribed the system of quarantine. By the Public Health Act of 1875, the defense of the country against cholera was placed in the hands of the Local Government Board, and regulations were issued by that board for the purpose. Instead of quarantining the entire crew of an infected or suspected vessel, the method adopted consisted in the medical inspection of the persons on board, and the separation and detention of those who were suffering from cholera or who were sus-

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pected of being affected. All others were permitted to leave the ship, but were traced and watched by the local authorities. Infected articles on board were to be disinfected or destroyed.

Quarantine has long been considered ineffective against the introduction of disease, besides being a source of much danger to those who were compulsorily detained under the system. The sanitary ideas of our day favor the less showy but safer methods long used in England in case of cholera.

In the United States under the law of 28 March 1890, known as the Interstate Quarantine Act, the supervising surgeon-general of the Marine Hospital Service is charged with preparing the rules and regulations, under direction of the Secretary of the Treasury, necessary to prevent the introduction of certain contagious diseases from one State to another, and he has also supervision of the medical inspection of alien immigrants, which, under the law of 3 March 1891, is conducted by the medical officers of the Marine Hospital Service. Under the act of 15 Feb. 1893, he is charged with the framing of regulations for the prevention of the introduction of contagious diseases and the prevention of their spread; and he is also charged with the conduct of the quarantine service of the United States. He has the direction of laboratories established to investigate the cause of contagious diseases, and publishes each week, under the title of 'Public Health Reports,' sanitary reports received from all parts of the United States and (through the State Department) from all foreign countries.

Quaritch, kwär'tch, **Bernard**, English bookseller: b. Worbis, Prussian Saxony, 23 April 1819; d. Hampstead, Middlesex, 17 Dec. 1899. In 1839-42 he was employed in a publishing house in Berlin, and in 1846 established himself in London. He was naturalized as a British subject in 1847, and in that year issued his first book catalogue, a single leaf. In 1848 he began issuing a monthly catalogue, which in 1854-64 was printed as a regular periodical under the title 'The Museum.' His business increased rapidly and he became known as an authority on rare and valuable books of all classes. For 30 years he practically controlled the rare book market, attending in person or by proxy every important book auction in England and America. His catalogues are remarkable productions, the first large one being published under the title 'Bibliotheca Xylographica, Typographica, et Palæographica' (1873) and afterward re-issued from time to time with valuable additions, the last complete catalogue being the 'General Catalogue of Old Books and Manuscripts' (1887-8, index 1892, 7 vols.) and increased by supplements in 1894 and 1897.

Quarles, kwär'lz, **Francis**, English poet: b. near Romford, Essex, 1592; d. London 8 Sept. 1644. He was educated at Cambridge and before 1629 went to Dublin as private secretary to Archbishop Ussher. In 1639 he was appointed chronologer to the city of London and at the opening of the civil wars wrote a work entitled 'The Loyal Convert.' Of the works of Quarles, in prose and verse, the most celebrated is his 'Divine Emblems,' a set of de-

signs illustrated by verses. A great part of them are borrowed from the 'Emblems' of Hermanus Hugo, but the verses are his own. His 'Enchiridion of Meditations' (1641) is a collection of brief essays and aphorisms, in vigorous and occasionally eloquent language.

Quarrying. Although there are at this time in the United States about 6,000 quarries in operation, with an annual product, valued at \$75,000,000, the quarrying industry has not kept pace with modern tendency and progress toward cheaper production. In building operations revolutionary changes have come about in the last few years in the erection of steel buildings and the manufacture of terra cotta and clay products, while quarrying has been, generally speaking, stationary. The natural result of this has been a large increase in the use of those materials for general bridge and building work, where the natural preference would have been for stone as an ideal and more permanent material, but for its prohibitive cost. As the rapid increase in the use of these other building materials is the direct result of the use of modern methods and machinery to the elimination of hand labor in the greatest degree, it follows that in this direction also lies the continued prosperity of the stone business. As a compromise between the minute subdivisions desired by scientists and the extremely general and often erroneous classification of quarrymen, the following division may be adopted for quarrying operations:

Limestones and Dolomites.—The sedimentary and bedded rocks, composed essentially of lime carbonate, or the mixed carbonates of lime and magnesia. Such have been found to pass into each other by insensible gradations, certain quarries producing at the same time material which, if classed on purely chemical grounds, would be relegated to both divisions.

Marble.—Including stones identical in composition with those noted under limestones and dolomites, but which through changes, mainly physical, have come to possess properties rendering them desirable for high-grade building or ornamental work. The marbles of New York, recently brought to light by The Adirondack Lumber and Mineral Corporation, for instance, are largely limestone, while those in Massachusetts, Berkshire County, are largely dolomite. With the marbles are also included a small series of serpentine rocks, which are likewise utilized for decorative purposes.

Sandstones and Quartzites.—Rocks composed essentially of consolidated sands, being made over, as it were, from the detritus of preexisting rocks. Those classed as *quartzites* are sandstones which have been rendered more or less crystalline through the deposition of silica between the original sand particles, as in the case with the *jasper* of Sioux Falls, South Dakota, or the Potsdam sandstone of St. Lawrence County, New York. The tuffs and other volcanic fragmental rocks are also here included.

Silica Sand.—Silica or siliceous sand includes not only sand suitable for the manufacture of glass, but also a large quantity designated as engine and furnace sand. It exists in several states as a sandstone, requiring crushing and screening; as a stone that

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readily disintegrates when exposed to the action of the elements, and needs only washing or burning to reduce the amount of organic matter and other impurities.

Siliceous Crystalline Rocks.—Here are included the true granites and syenites, together with trappau rocks, such as are often designated as black granites; the gneisses or so-called striped or bastard granites; the mica schists; and melaphyre, basalt, andesite, syenite, elaeolite, diabase, gabbro, diorite, and other volcanic rocks.

Slate.—Including argillaceous rocks, which, through the process of shearing and incidental chemical activity, have undergone a partial metamorphism, resulting in the development of a pronounced tendency to split along certain planes, which may or may not be parallel with the original bedding, into thin sheets suitable for roofing purposes. It is necessarily a consequence that such are restricted to the regions of pronounced earth movements, such as have resulted in the formation of mountain ranges.

The possible resources of the various States of the Union are as follows:

State or Territory.	Present and Prospective Resources.
Alabama	Granite, Limestone, Marble, Sandstone, Slate.
Arizona	Dolomite, Granite, Onyx, Marble Sandstone, Trappean Rocks, Volcanic Rocks, and Tuffs.
Arkansas	Elaeolite Syenite, Granite, Limestone, Marble, Sandstone, Slate.
California	Granite, Limestone, Marble, Sandstone, Slate, Trappean Rocks, Verd Antique Marble, Volcanic Rocks, and Tuffs.
Colorado	Granite, Limestone, Marble, Quartzite, Sandstone, Trappean Rocks, Volcanic Rocks and Tuffs.
Connecticut	Diabase, Gneiss, Granite, Limestone, Marble, Sandstone, Verd Antique Marble.
Delaware	Gabbro, Gneiss, Limestone, Quartzite, Serpentine.
Florida	Limestone (shell and oolitic).
Georgia	Gneiss, Granite, Limestone, Marble, Sandstone, Slate, Verd Antique Marble.
Idaho	Dolomite, Granite, Limestone, Marble, Sandstone, Trappean Rocks, Volcanic Rocks, and Tuffs.
Illinois	Dolomite, Limestone, Sandstone.
Indian Territory	Dolomite, Granite, Sandstone, Limestone.
Indiana	Dolomite, Limestone, Sandstone.
Iowa	Dolomite, Limestone, Sandstone.
Kansas	Dolomite, Limestone, Sandstone.
Kentucky	Dolomite, Limestone, Sandstone.
Louisiana	Limestone, Sandstone.
Maine	Gneiss, Granite, Limestone, Sandstone, Slate, Trappean Rocks, Verd Antique Marble.
Maryland	Gneiss, Granite, Limestone, Marble, Sandstone, Slate, Verd Antique Marble.
Massachusetts	Gneiss, Granite, Limestone, Marble, Sandstone, Slate, Trappean Rocks, Verd Antique Marble.
Michigan	Dolomite, Gneiss, Granite, Limestone, Sandstone, Slate.
Minnesota	Dolomite, Gneiss, Granite, Limestone, Quartzite, Sandstone, Slate.
Mississippi	Limestone, Sandstone.
Missouri	Diabase, Dolomite, Granite, Limestone, Sandstone.
Montana	Dolomite, Gneiss, Granite, Limestone, Marble, Sandstone, Trappean Rocks, Volcanic Rocks, and Tuffs.
Nebraska	Dolomite, Sandstone, Limestone.
Nevada	Dolomite, Granite, Limestone, Marble, Sandstone, Slate, Trappean Rocks, Volcanic Rocks, and Tuffs.
New Hampshire	Gneiss, Granite, Limestone, Slate.
New Jersey	Diabase, Dolomite, Gneiss, Granite, Limestone, Marble, Sandstone, Slate,

State or Territory.	Present and Prospective Resources.
New Mexico	Granite, Limestone, Marble, Sandstone, Trappean Rocks, Verd Antique Marble, Volcanic Rocks, and Tuffs.
New York	Dolomite, Gneiss, Granite, Limestone, Marble, Norite, Sandstone, Slate, Trappean Rocks, Verd Antique Marble.
North Carolina	Dolomite, Gneiss, Granite, Limestone, Marble, Sandstone, Serpentine, Slate, Trappean Rocks.
North Dakota	Dolomite, Sandstone, Limestone.
Ohio	Dolomite, Sandstone, Limestone.
Oklahoma	Dolomite, Sandstone, Limestone.
Oregon	Dolomite, Granite, Limestone, Sandstone, Trappean Rocks, Volcanic Rocks, and Tuffs.
Pennsylvania	Diabase, Dolomite, Gneiss, Granite, Limestone, Marble, Sandstone, Slate, Serpentine.
Rhode Island	Dolomite, Gneiss, Granite, Limestone.
South Carolina	Gneiss, Granite, Limestone.
South Dakota	Limestone, Quartzite, Sandstone.
Tennessee	Granite, Limestone, Marble, Sandstone, Slate.
Texas	Granite, Limestone, Marble, Sandstone, Slate, Trappean Rocks, Volcanic Rocks, and Tuffs.
Utah	Granite, Limestone, Marble, Onyx Marble, Sandstone, Trappean Rocks, Volcanic Rocks, and Tuffs.
Vermont	Dolomite, Gneiss, Granite, Limestone, Marble, Slate, Verd Antique Marble.
Virginia	Diabase, Dolomite, Gneiss, Granite, Limestone, Marble, Sandstone, Slate.
Washington	Granite, Limestone, Marble, Sandstone, Trappean Rocks, Verd Antique Marble, Volcanic Rocks, and Tuffs.
West Virginia	Calcareous Tufa, Limestone, Sandstone, Travertine.
Wisconsin	Dolomite, Gneiss, Granite, Limestone, Sandstone.
Wyoming	Granite, Limestone, Marble, Sandstone, Trappean Rocks, Volcanic Rocks and Tuffs.

In the earlier days of the stone industry hand methods were employed almost exclusively in the work of quarrying and dressing. The past twenty-five years has, however, witnessed the introduction of machinery and consequent changes. The old method of drilling and blasting, formerly applied to all classes of rocks, is now done away with, excepting in the very hardest and toughest of materials, or where, as in the case of the trappeau rocks, the material is to be utilized only for roads. Even where drilling and blasting are now resorted to, it is the custom to drill a series of holes in the line along which it is desired the stone shall break; these holes are then charged somewhat lightly and fired simultaneously. In this way the force of the explosion is delivered along a considerable surface and the danger of shattering the material through the sudden jar is reduced to a minimum. This process is at present largely limited to granite rocks which are too hard to be quarried by means of channeling machines.

Plug and Feather Work.—In quarries where good breaks require that the splitting strain be exerted well down in the ledge, experience has shown that the best method for getting out the material is usually the *plug and feather* system, in which a series of holes from 1¼ to 2 inches in diameter and of a depth from 2-3 to the full thickness of the sheet are drilled at intervals depending upon the character of the stone and its manner of cleavage. Long metal wedges or plugs are then driven into these holes and the material split away in fairly regular blocks which must otherwise be cut to size by hand.



A MARBLE QUARRY AND PLANT AT PROCTOR, VERMONT.

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In soft material such as sandstone, a drill mounted on the usual tripod finds frequent use, and this is far superior to hand methods, still in certain classes of work a drill mounted on quarry bar will do much more and better work. The advantages of the quarry bar are that all the holes are drilled to double length, intermediate ones being shallow. The lower half of the deep holes is drilled with a smaller drill bit so as to alternate the plug strain top and bottom and control the break by skillful sledging.

The wedges of the short hole tend to split along the top and those of the long hole split along the bottom, thus distributing the pressure and tending to split the stone in a clean, smooth plane, and largely avoiding any tendency to run off. This distribution of splitting strains is to be worked out by experience in the peculiarities of the different ledges. The wedges or plugs need not in all cases be of a length equal to the depth of the holes. In some marble quarries, plug holes only 5-8 inch in diameter are put clear through the blocks, sometimes 10 feet deep, to weaken the line and insure a straight break, the plugs, however, being shorter.

Broaching.—In granite and other hard stones holes must be placed closer together and, as a rule, splitting across the grain is abandoned in favor of *broaching*. In this system, a series of holes is drilled, usually about 3 inches apart from center to center, depending upon the hardness of the rock, and a flat bit or "broach" is substituted for the regular steel. This has a face about 3-4 by 3 inches, and is forged with a blunt end to crush this thin wall or web between the holes. Drills used for broaching must have the release rotation, which is a simple device to throw the pawls out of action and allow the drill to work without rotating. Broach channeling is the best and cheapest method of cutting out key blocks, lumps, and making wall cuts, etc., in granite quarries, where the rock is too hard to be cut advantageously with the regular channeling machine.

Channeling Machines.—Channeling machines are utilized in the case of rocks of the nature of marble, limestone, and the softer sandstone, since they would be liable to injury through blasting and since it is desired to remove the materials from the quarry bed with a minimum amount of waste and in such size and shape that they may be cut into suitable dimensions. The Wardwell channeling machine, the earliest in use, has given way to the direct-acting stone channeling machine, the design of which was based upon the conviction that the same principles which had made the Ingersoll-Sergeant drill famous, would, properly applied, give the best results in cutting a channel. It was believed that the direct-acting machine possessed points of decided advantage over the slow, cumbersome diamond and lever types of rock-cutting machinery of that day. Although certain shortcomings appeared in the first models, still it is an interesting fact that some of these first machines are in service today after more than fifteen years of continuous use and are still doing good work. The success of these pioneer types demonstrated beyond question the merit of the direct-acting principle now everywhere conceded as the correct one and it remained only to develop to the utmost the details of mechanical construction.

This machine is primarily suited for the

heaviest work and the deepest cuts, in open quarries of limestone, sandstone, slate, and other materials, where the output is in dimension stone. In this service it has found its greatest field in making the long, deep, longitudinal cuts which are preliminary to further breaking by the plug and feather method. It has found another valuable field of application in certain classes of heavy contracting work, such as canals and reservoirs. The advantage of the track channeling machine in this work is threefold; first, the limits of excavation can be distinctly marked by channeling along the limiting line and shooting out within this mark; second, the quantity of rock to be broken and removed is confined strictly to the limits of cut—an item often of great consequence when competition is keen and prices low; third, the walls of the excavation are left smooth and solid, requiring the minimum of attention and maintenance. A notable instance of this canal work was seen in the Chicago Drainage Canal, where more than thirty track channelers of an earlier type were employed. The machines were also used in certain work in the enlargement of the Erie Canal and their performance was eminently satisfactory.

The average cut with these channeling machines is from eight to sixteen feet in depth, depending upon the nature of the stone. The gauge or width of the cut will depend upon the final depth sought. It may be from one and one-half to four inches at the start reducing to a width of one and one-eighth inches with the last steels. The length of the channel is limited only by the length of track which can be used. Cutting speeds vary with the quality of rock and the handling of the machine. There are cases on record where the machine channeled 700 square feet in ten hours in völitic limestone, during part of which time over 100 square feet per hour was cut. In Ohio sandstone of medium hardness, 260, 280 and 300 square feet per day of ten hours have been channeled and these rates are being maintained as an average by the month. The average cost in this case runs from two and one-half cents to three and one-half cents per square foot cut. On the Chicago Canal the cost was fifteen cents per square foot.

Helicoidal Saws.—Recent attempts have been made to introduce the so-called helicoidal saw for quarrying the softer rocks; as limestone and marble, but with only partial success and that in the larger limestone quarries of the Middle West, owing apparently to the large amount of labor necessary for putting the saw in position and the waste involved in cutting out the corners in which the pulleys are run. The saw, as is well known, consists of a twisted iron-wire rope, generally three-sixteenths of an inch in diameter, running over sliding pulleys, the abrading material being either sand or chilled iron, as the case may be.

After the stone is removed from the quarry bed it is worked into the desired shape and size by a process dependent largely upon the hardness of the stone. Formerly a block after being reduced to an approximately rectangular form by means of hand *plug and feather* splitting, was still further reduced by pitching tools, followed when necessary by such implements as the point, ax, pean hammer, and bushhammer. Pneumatic tools are gradually replacing these hand implements. Pneumatic surfacing machines, lathes

QUART — QUARTER-SESSIONS

and planers are now in use at the larger quarries. Indeed, the production of cylindrical columns by the old hand method has been almost entirely superseded by the use of lathes similar to those used in turning metals. Except on the harder stone, like granite and quartzite, saws are extensively used for splitting up material into rectangular masses and slabs where smooth, even surfaces are desired.

Electricity in Quarrying.—The quarrying industry today constitutes an important field for the application of electric current, and the subject has become so important as to create a literature and a technology of its own, for many of the problems involved are such as do not arise in connection with other work. The flexibility of electric circuits and the general adaptability of electric power have led to a wide range of applications, some of which are still in the experimental stage. Motors and other necessary equipment have been designed for special requirements. Beginning with a small direct current station and leading up to a complete high tension transmission and converting system, the use of electricity in mining and quarrying is very similar to its application to street railway work. Special motors for the equipment of mine locomotives have been designed to meet the peculiar conditions confronted in mining and quarry work. A recent application is that of the gathering locomotive which is to a great extent replacing animal haulage completely. This locomotive is equipped with a reel and cable, supplying power to it when gathering cars from rooms where no trolley is installed and where wooden rails are used. Standard motors are applicable to and are largely used on hoists, ventilating fans and drainage pumps.

The transmission of power over long distances by polyphase alternating current is one of the most notable and important developments in electricity. It has been a chief factor in the marvelous development of the far west. Much of the progress in the country west of the Rockies is directly traceable to the use of electricity which, in many cases, generated at a distant waterfall, is transmitted to commercial centers where the power can be used as desired.

In a typical quarrying operation 100 men were formerly required to produce 5,000 tons of marble; now, since scrapping most of the plant and substituting modern machinery, 10 men produce 6000 tons in the same time. The argument has been presented in all sincerity, that mechanical methods cannot be used to the same advantage in quarrying rock as in the case of general manufacturing. To some extent this is true, depending upon the class of quarrying; for instance, in some quarries producing rough rubble without regard to size or dimensions, the mechanical features are confined to drilling, electrical blasting and suitable hoisting apparatus and perhaps pumping or crushing, with the occasional use of steam shovels. There can be no question as to the economy of machine drilling over hand drilling, and the harder the material and the more difficult to drill by hand, the greater is the advantage of machine drilling.

Successful quarries are those which closely approach the ideal of eliminating hand labor and, as in other profitable operations, are the result of heavy investments in all the machinery

which can be used up to that point where additional apparatus will not reduce the waste. The modern methods of clanneling, plug and feather work, power wedge hole cutters and the use of compressed air, very nearly reach this point as it calls for few machine operators, a few men to bar out the stone so loosened, and a gang of derrick men to place it on the cars for shipment in that attractive form best calculated to hold and expand the market at the highest trade price for the product. In most quarries, the operating period is limited by the comparative shortness of the working season, and therein lies another advantage of machinery. Again, the smaller the force, the more easily it is controlled and the better the opportunity for sifting the men down to a picked gang of machine runners, men who, at a slight addition over the prevailing rate of wages, will not only do very much more work, but will come nearer to the production of a perfect output without wasteage.

There exists in the stone industry the same tendency toward the concentration of capital and the formation of stock companies as in other branches of trade. This is due not altogether to the desire for combination with a view to controlling trade, but in part at least to a change which has taken place in the character of the industry. The installation of costly machinery and the fact that the quarries in many cases now contract not merely to furnish the stone, but to furnish it cut and ready for its definite position in the structure, even if they do not contract to set it in place as well, involve a larger capitalization and supply of available funds. See MINES AND MINING; MINING AND MILLING MACHINERY; BUILDING MATERIALS; ETC.

EDWARD S. FARROW,
Consulting Mining Engineer.

Quart. See WEIGHTS AND MEASURES.

Quarter. See WEIGHTS AND MEASURES.

Quarter-crack. See SANDCRACK.

Quarter Days, the days which begin the four quarters of the year, namely: 25 March, or Lady-day; 24 June, or Midsummer-day; 29 September, or Michaelmas-day; and 25 December, or Christmas-day. In England and Ireland it is usually contracted between landlord and tenant that rent should be paid, and that houses may be entered or left on these days. In Scotland there are two legal term days. Whitsunday (15 May) and Martinmas (11 November). There are also two conventional terms, Candlemas (2 February) and Lammas (1 August), on which rents are frequently paid. In the United States, in law, quarter days are the 1st of January, April, July, and October. In the relation between landlord and tenant in some of the States they are the 1st of May, August, November, and February, respectively.

Quarter Dollar, in American coinage, a silver piece of the value of 25 cents. Its issue was first authorized (weight, 104 grains) by Congress in 1792, and its coinage was begun in 1796. It was reduced to 93 grains in 1853. This coin is legal tender to the amount of \$10. There were no issues of the quarter dollar during the years 1798 to 1803, inclusive, 1808 to 1815 inclusive, 1817, 1824, 1826 and 1830.

Quarter Sessions. See COURT.

QUARTER-STAFF—QUARTZ

Quarter-staff, an old English weapon formed of a stout pole of heavy wood, about six feet long, loaded with iron at both ends.

Quartering Acts, acts of the British Parliament which did away with certain of the penalties of high treason as prescribed by law in ancient times. The offender, if a man, was drawn on a hurdle to the place of execution, there hanged by the neck till he was dead, the head severed from the body, the body disemboweled and divided into four quarters, and the head disposed of at the pleasure of the king. If the offender was a woman she was drawn to the place of execution and there burned alive. By successive acts of the parliament (30 Geo. III. ch. 48, and 54 Geo. II. ch. 146) the punishment of a female traitor was changed to hanging; and, in the case of men, the crown might change the sentence to beheading, or might remit it wholly. Under the felony act of 1870 hanging is made the one penalty of treason; but as the act 54 Geo. III. ch. 146 was not repealed, the offender, if a man, may by crown warrant be beheaded.

Quartermaster, (1) in military affairs, an officer who superintends the issue of stores, food, and clothing, and arranges transportation for a regiment when necessary. (2) In nautical affairs, a petty officer who, besides having charge of the stowage of ballast and provisions, coiling of ropes, etc., attends to the steering of the ship. He is appointed by the captain.

Quartermaster-general, in the army of the United States, a staff-officer with rank of brigadier-general. He is chief officer in the quartermaster's department. In England he is a staff-officer, specially appointed for duties connected with quartering, encamping, embarking, and moving troops. In both armies in the field he is responsible for the surveys and reconnaissance necessary for the conduct of the army, and has the general direction of the railway, postal, signaling, and telegraph services.

Quartermaster-sergeant, in the United States army, an officer whose duty it is to assist the quartermaster. In England the senior sergeant in the quartermaster's department of a regiment. He ranks next the sergeant-major.

Quartern. See WEIGHTS AND MEASURES.

Quartermoon. See QUADROON.

Quartet, or **Quartette** (Italian *quartetto* from *quarto*, a fourth), a musical composition for four voices or instruments, in which all the parts are *obbligati*, that is to say, each is indispensable to the just performance of the piece; no one part can be omitted without injuring the proper effect of the composition. Vocal quartets are generally accompanied by instruments to sustain the voices, but the most artistic effect is produced by their perfect rendition unaccompanied. An interchange of melody, whereby the parts become in turn principal and subordinate, without any interweaving of them, does not constitute a quartet (see POLYPHONY). Quartets for stringed instruments are generally arranged for two violins, a viola or tenor violin, and a violoncello. Haydn was the originator of the modern instrumental quartet, and his contemporary emulators were Mozart, Beethoven, Gietry, Sammartini, Onslow, the two Rombergs, and Ries. Among later masters of the quartet form are Schubert and Brahms.

Quartier Latin, kār-tē-ā lā-tān. See PARIS.

Quartley, kwārt'li, Arthur, American artist: b. Paris 24 May 1839; d. New York 24 May 1886. Coming to the United States in 1851, he studied in Baltimore and New York and was elected National Academician in 1886. His most important works are marines, and among them may be mentioned 'New York from North River'; 'Afternoon in August—Coast of Maine' (1778); 'Low Country on the North Shore of Long Island' (1881); and 'Off the Shoals.'

Quarto, the name applied to the size of a book, in which a sheet makes four leaves, frequently abbreviated to 4to. Also a book formed by folding a sheet twice, making four leaves, eight pages. The term, by modern usage, refers to a book of nearly square form.

Quartodecimans, kwār-tō-dēs'i-manz, the name given to those Christians in the early centuries who celebrated the Easter festival on the same day as the Jews celebrated the Passover, namely the 14th day of the month Nisan. Most of the churches, both of the East and West, celebrated the Christian Passover always on the Sunday next succeeding the day observed by the Jews, never on 14th Nisan, even if that day was Sunday. The Council of Nice (325 A.D.) enjoined on all the faithful this rule; thereafter the Quartodecimans were held to be heretics.

Quartz, the name given native oxide of silicon, SiO₂. It is a widely distributed mineral, occurring not only as veins and segregated masses, but as a common constituent of igneous rocks. Detrital grains form sands, sandstones, and quartzites. Owing to differences in color and texture and its use as a semi-precious stone, the names given varieties of quartz are many. All these varieties, however, are included in two classes, the plainly crystalline or vitreous, and the obscurely crystalline called crypto-crystalline. All varieties have about the same hardness, 7, that is, can scratch window glass, and nearly the same specific gravity, 2.6. Pure quartz is fusible only at high temperatures.

Quartz crystallizes in the rhombohedral system, generally as six-sided prisms usually terminated at each end by six-sided pyramids. Among the crystalline varieties of quartz are rock crystal, amethyst, smoky quartz, rose quartz, milky quartz, the mineral being colorless when pure, but ranging through various shades of yellow, red, brown, blue, and green to black when impure. Colorless quartz, or rock crystal, is often cut into gem shapes and sold as Lake George diamonds, Brazil pebbles, etc. Perfectly clear crystals of larger size are highly prized in Japan, when cut and polished as spheres. Recently developed uses of rock crystal are in the manufacture of fibres for suspending the minute magnets and mirrors used as galvanometers and in the manufacture of spectrum tubes and test tubes, the quartz being fused by the oxyhydrogen blow-pipe. Quartz fibres are used for galvanometers because they show no torsion and the minors have no permanent set or deviation from the true position when at rest. Vessels made of fused quartz can be heated to a white heat and plunged into cold water without injury and on this account quartz tubes are used for studying the spectra gases at high temperatures.

QUARTZ PORPHYRY — QUATERNIONS

Of the colored varieties of crystalline quartz amethyst is clear purple or bluish-violet, and is popular as a gem; rose quartz, which always occurs massive, is rose red or pink; yellow quartz, or citrine, is often called topaz by jewelers, but may be distinguished from true topaz by its inferior hardness; smoky quartz, called also cairngorm stone, varies in color from smoky yellow to brownish black; milky quartz, white, nearly opaque and often with a greasy lustre, is of common occurrence in veins; sagenitic quartz has inclusions of needle-like crystals of rutile, actinolite, asbestos (cat's-eye) or black tourmaline; sapphire quartz indigo blue in color, is a rare variety. Many quartz crystals contain small cavities partly filled with liquids, generally water, also inclusions of carbonic acid, either liquid or gaseous. The cryptocrystalline varieties of quartz include chalcedony, and its varieties, carnelian, chrysoprase, prase, plasma, agate, onyx, and sardonyx; also flint, hornstone, touchstone, and jasper. Chalcedony has a wax-like lustre, is translucent or transparent, and its color varies from white through pale brown to dark brown or black, though it is occasionally blue; carnelian, or sand, is a red or brownish-red chalcedony; chrysoprase an apple-green variety; prase, a dull darker green; plasma, a leek green or emerald green; bloodstone, a dark green chalcedony with small red spots, like drops of blood; agate, a chalcedony with delicate parallel bands of color, or irregularly clouded color effects, the colors being white, red, brown, or even blue, while moss agate contains moss-like forms caused by oxide of manganese; in onyx the differently colored bands are straight and parallel; sardonyx is onyx containing bands of carnelian (sand); flint differs from chalcedony in being more opaque, having a slightly vitreous lustre, being generally gray or brown in color; it breaks with a sharp cutting edge; it was used by the early races of men for arrow heads, knives, etc.; hornstone resembles flint, but has a splintery fracture, and is often white; touchstone, known also as basanite or Lydian stone, a black hornstone or jasper, used for testing the purity of precious metals by rubbing them on it; jasper differs from the preceding varieties in being entirely opaque; it is often red, yellow, or brown.

Common milky quartz is used for a variety of purposes. In metallurgical operations it is used as a flux in smelting iron and copper ores; when finely crushed it is used by porcelain manufacturers for making glazes, quartz sand and ground pure quartz are used in immense quantities for making glass. Another use is as an abrasive, either as sandpaper or as sand or a fine powder. In these forms it is used for dressing stone, wood, and leather; while the powder, mixed with soap, forms a widely advertised cleansing compound.

Quartz Porphyry, an igneous rock characterized by containing crystals of quartz and feldspar with sometimes biotite and more rarely hornblende scattered through a ground mass that is glassy or contains fine crystals of quartz and feldspar. The name was formerly given to free Tertiary rhyolites and is still applied to rhyolites that have crystallized as dikes or laccolites rather than as surface flows, but these distinctions have little value. In general quartz porphyries differ from rhyolites simply in being denser. Quartz trachyte is a name given rhyo-

lite by European geologists. Quartz porphyries are of quite common occurrence in the Western States and are of peculiar importance at Leadville, Colo. See RHYOLITE.

Quartzite, a sedimentary rock of common occurrence in mountain ranges or when strata have been strongly folded. It is simply a metamorphosed sandstone, its hardness and rather crystalline character being due to the cement of crystalline quartz that surrounds the grains of the original sandstone. A sandstone containing clay becomes a quartzite containing mica, and thus quartzites grade into quartz-schists and mica-schists. In general, quartzites resist weathering and thus form ledges. They differ greatly in color. See also GLACIAL PERIOD.

Quasimo'do, in the Roman calendar, a term applied to the first Sunday after Easter, from the opening words of the introit for that day, "*quasi modo geniti infantes*," as infants lately born. Also the name of a well known character in Victor Hugo's novel 'Notre Dame de Paris.'

Quass, kwäs, or **Kvass**, a Russian beverage, made by pouring warm water on rye or barley meal. It is sour and fermented.

Quas'sia, a genus of shrubs and trees of the order *Simarubacea*. The best known species (*Q. amara*) is indigenous to tropical America, grows about 12 feet tall, bears large pinnate leaves with winged petioles, and racemes of bright red blossoms. The wood is used for cabinet making and for furniture, since it is avoided by insects. It is excessively bitter, and was formerly in repute as a medicine and for augmenting the bitterness of ale, porter, beer, and similar beverages. It is known also as bitterwood, by which name the wood of *Picræna excelsa* is likewise designated and used as a substitute for true quassia with which it vies in bitterness.

Quaternary, or **Post-Tertiary Period**, in geology, the fourth great division of the fossiliferous strata, which embraces the Pleistocene or Glacial and Post-Glacial (q.v.) and recent systems. See POST-PLIOCENE.

Quaternions. *Fundamental Principles*.—A quaternion, or "set of four," is a quadrinomial of the form

$$w + xi + yj + zk,$$

in which w, x, y, z are numbers, and i, j, k are four independent units, any three of which may be interpreted geometrically as a set of mutually perpendicular straight lines of unit length in three-dimensional space. The binary products xi, yj, zk are three mutually perpendicular line-segments of lengths x, y, z respectively: they are called *vectors*, while pure numbers, positive or negative, are called *scalars*.

The calculus of quaternions is an algebra in which the fundamental operations of addition, subtraction, multiplication, and division, and the consequent operations of involution, evolution, etc., are employed, and whose elements (operators and operands) are quaternions. It is a multiple algebra, because a quaternionic symbol, as q , contains implicitly several independent quantities, and it is essentially geometric, because its operations, addition, multiplication, etc., may be interpreted

QUATERNIONS

as geometric transformations. For example, in illustration of the last statement, if q, r be two quaternions and be taken to represent two line-segments meeting at a point, their sum is the diagonal of the parallelogram of which q and r are two adjacent sides. This is known as geometric addition; its law is that of the parallelogram of forces. Multiplication by a quaternion is equivalent to an orthogonal transformation in four variables plus an expansion or a contraction. The geometrical construction of a quaternion product, however, needs the hypothesis of a four-dimensional space for its proper presentation.*

Vectors in particular are so defined as to obey the law of geometric addition. If several vectors represent the successive parts of a broken line in space, their sum is the line-segment joining the free ends of the broken line. In this process of addition the line-segments representing vectors may be transferred to any positions in space, provided they remain parallel to their original directions, but the direction-sense must in every case be preserved.

In obedience to this interpretation a quaternion may always be written as the sum of a scalar and a vector; thus,

$$q = Sq + Vq,$$

wherein S and V are to be read 'scalar of' and 'vector of' respectively; for, by the law of geometric addition $xi + yj + zk$ is itself a vector, while w , being a pure number, is by definition a scalar.

In the quaternion algebra the laws of association and distribution in the four fundamental operations, and the law of commutation in addition and subtraction, are assumed, or they may be derived from the geometrical definitions of the processes, but the commutative law in multiplication and division is rejected except for such quaternions as have vector parts that are numerical multiples of one another.

The laws of combination by multiplication are determined in the following manner: The mutually perpendicular vectors xi, yj, zk are numerical multiples of the three independent units, i, j, k , and the combinatory laws for these units are derived from the assumptions

$$i^2 = j^2 = k^2 = -1, \quad ijk = -1,$$

from which are obtained, through multiplication by i, j, k in succession, the remaining binary products

$$jk = -kj = i, \quad ki = -ik = j, \quad ij = -ji = k,$$

From these laws it follows that the product of two quaternions is itself a quaternion. Thus q and r being given quaternions,

$$\begin{aligned} q &= w + xi + yj + zk, \\ r &= w' + x'i + y'j + z'k, \end{aligned}$$

their product has the form

$$qr = W + Xi + Yj + Zk,$$

wherein

$$\begin{aligned} W &= ww' - xx' - yy' - zz', \\ X &= wx' + w'x + yz' - y'z, \\ Y &= wy' + w'y + zx' - z'x, \\ Z &= wz' + w'z + xy' - x'y. \end{aligned}$$

If the order of the factors in this product be changed from qr to rq , the scalar part $ww' - xx' - yy' - zz'$ is unaltered, but the terms $yz' - y'z, zx' - z'x, xy' - x'y$ change their algebraic signs and therefore the vectors of qr and of rq are different. This result shows that in general quaternion multiplication does not obey the commutative law. In order that the above terms may not change sign (by a reversal of the order of the factors q, r) they must be separately zero, that is,

$$\frac{y}{y'} = \frac{z}{z'}, \quad \frac{z}{z'} = \frac{x}{x'}, \quad \frac{x}{x'} = \frac{y}{y'},$$

in other words, x', y', z' must be the same numerical multiples of x, y, z respectively. This makes $x'i + y'j + z'k$ a numerical multiple of $xi + yj + zk$, and it is the condition under which it is permissible to write $qr = rq$.

Division is interpreted by introducing the reciprocal, defined by the equation $qr = 1$, in which q and r are said to be reciprocal to one another, and, as in ordinary algebra, we write $r = q^{-1}$ and $q = r^{-1}$. This product obviously obeys the commutative law and also it has no vector part, so that

$$x' = nx, \quad y' = ny, \quad z' = nz, \quad [n = \text{a number}]$$

and

$$wnx = -w'x, \quad w' = -nw.$$

Hence the reciprocal of q must have the form

$$q^{-1} = \frac{1}{m} (w - xi - yj - zk),$$

where m is a number. By forming the product qq^{-1} , observing the laws $i^2 = j^2 = k^2 = -1, ij = -ji = k$, etc., it is easily shown that

$$m = w^2 + x^2 + y^2 + z^2.$$

This number is called the *norm* of q .

It is now evident that the quotient rq^{-1} is obtained by writing out the product

$$(w' + x'i + y'j + z'k) \cdot \frac{1}{m} (w - xi - yj - zk),$$

and that this quotient is a quaternion.

Hence, barring critical cases, such as division by zero, indeterminate forms, etc., the application of the four fundamental processes of algebra to quaternion symbols leads always to determinate quaternion results. The quaternionic algebra is therefore a closed system and satisfies the definitions of a group. (See THEORY OF GROUPS.)

The positive square root of the norm of q ($= \sqrt{w^2 + x^2 + y^2 + z^2}$) is called its *tensor* and the quotient of q by tensor of q is called its *versor*, so that a quaternion is always the product of its tensor and versor. The symbolic form of this statement is

$$q = Tq \cdot Uq,$$

where T and U stand for tensor and versor respectively.

In the strictly symbolic notation the reciprocal of q has the form

$$q^{-1} = \frac{Sq - Vq}{T^2q},$$

and since $qq^{-1} = 1$ it follows that

$$S^2q - V^2q = T^2q.$$

* See 'Bulletin of the American Mathematical Society' (vol. 11, p. 437).

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The quaternions $Sq + Vq$ and $Sq - Vq$ are said to be *conjugates* of one another.

A vector has no scalar part, but it has a tensor factor and a versor (vector of unit length); and a scalar has no versor part, but it has a tensor, its positive numerical value, and a versor whose value is always ± 1 . The symbolic statements are

$$Vq = TVq \cdot UVq,$$

$$Sq = \pm TSq.$$

Therefore, also,

$$V^2q = -T^2Vq, \quad S^2q = T^2Sq.$$

The equation $S^2q - V^2q = T^2q$ may now be written

$$S^2q + T^2Vq = T^2q,$$

and hence, θ being an appropriate angle, it may be assumed that

$$Sq = Tq \cdot \cos \theta, \quad Vq = Tq \cdot UVq \cdot \sin \theta.$$

By the introduction of these expressions for scalar and vector the quaternion is presented in a new binomial form

$$q = Tq(\cos \theta + UVq \cdot \sin \theta),$$

one of great importance and utility.

The formula last written is a particular case of a more general geometric law. A recent interpretation makes quaternion symbols represent straight-line segments (their directions included) in four-dimensional space.* Interpreted in this way quaternions are called *directors*. It is shown that if two quaternion directors be perpendicular to one another their quotient is a vector. Let θ be the angle between p and q , let s be the director perpendicular dropped from the terminal extremity of q to p , and r the director from the origin (intersection of p, q) to the foot of this perpendicular. Then by geometric addition

$$q = r + s$$

and

$$q/p = r/p + s/p;$$

and s/p , being the quotient of a pair of mutually perpendicular directors, is a vector. Hence, if ρ be the ratio Us/Up , it is a unit vector and

$$q/p = \frac{Tq}{Tp}(\cos \theta + \rho \sin \theta).$$

When $p=1$ this equation reduces to the one previously written for the value of q . In this particular case θ becomes the angle formed by the quaternion director q with the axis of real quantities, or scalar axis. When p and q are both vectors the formula expresses the fact, on which Hamilton places early emphasis, that the ratio of two vectors is in general a quaternion, but that if the vectors meet at a right angle the ratio is another vector, if they be parallel it is a scalar. But the formula also shows that these statements are true of quaternions in general.

The two parts of the equation last written present the quaternion under its three most fundamental aspects:

1. It is the ratio of two directed, non-positived,† straight-line segments.

2. It is the sum of a number and a directed, non-positived vector.

3. It is the product of a tensor (tensor of q/p) and of a versor, the latter being expressed in terms of its angle θ , and its vector axis ρ .

The geometrical and kinematical interpretations of geometric addition and subtraction involve no special difficulties. They are fully explained in a variety of treatises in which this subject has its natural place, particularly in those parts of mathematical physics where the composition of velocities and of forces is explained. The first full exposition of the subject was given in the celebrated 'Barycentrische Calcul' of Möbius, published in 1827, and was therefore well known about sixteen years before the invention of the calculus of quaternions by Hamilton.

The non-commutative character of multiplication greatly enlarges its powers of expression and discrimination, but it also introduces troublesome transformation processes and calls for extended analysis. Fully expressed, the quaternion product has the double form $q()q_1$ and involves eight scalar quantities. A first step in its analysis resolves it, in either of two important ways, into simpler factors:

1. Since by the law of association

$$q()q_1 = [q()1]q_1 = q[1()q_1]1,$$

it consists of the two special commutative operators $q()1$, $1()q_1$, applied in succession, or simultaneously, at pleasure.

2. It is always possible to determine four versor quaternions r, s, r_1, s_1 , that satisfy the following conditions:

$$Uq = rs = sr, \quad Uq_1 = r_1^{-1}s_1 = s_1r_1^{-1},$$

and

$$Sr = Sr_1, \quad Ss = Ss_1.*$$

The given product then assumes the form

$$mq()q_1 = mr[s()s_1]r_1^{-1} = m[s(r()r_1^{-1})]s_1,$$

where m is a number. It consists of a tensor factor and two rotational transformations $r()r_1^{-1}$, $s()s_1$, which are commutative and may be applied simultaneously, or in succession.

The interpretation of the special products $q()1$, $1()q_1$, $r()r_1^{-1}$, $s()s_1^{-1}$, as motions, "turns," and "rotations," generally in a space of four dimensions, has been successfully achieved.† An adequate account of them, however, would expand this notice beyond permissible limits. No accurate description of the motion represented by the general product $q()q_1$ has yet been given.

A simpler case than any of the preceding is the product $q()q^{-1}$. Its complete interpretation as a rotation in three-dimensional space was an early achievement by Hamilton himself. The motion consists of a rotation through twice the angle of q (q being given in the form $m[\cos \theta + \rho \sin \theta]$) about the vector of q as an axis; that is, any vector, placed at the origin, moves through the angle 2θ , on the

* 'Proceedings of the American Association for the Advancement of Science' (vol. 33, 1884, pp. 55-56).

† See Hathaway in 'Transactions of the American Mathematical Society' (vol. 3, 1902, pp. 46-59), and Stringham in 'Proceedings of the American Association for the Advancement of Science' (vol. 33, 1884, p. 56).

* 'Transactions of the American Mathematical Society' (vol. 2, pp. 183-214, and vol. 3, pp. 49-59).

† Not placed in a definite position.

QUATERNIONS

surface of a cone having its vertex at the origin.*

Quaternion multiplications may be expressed in terms of matrices. This fact was first established by Peirce,† afterwards verified by Spottiswoode,‡ but more explicitly by Cayley.§ It has also been shown that every orthogonal transformation in four variables is expressible as a quaternion product.|| Such facts as these bring out clearly the multiple character of the quaternion algebra.

The further development of the theory of quaternions, which follows the exposition of fundamental principles outlined in the preceding paragraphs, includes the deduction of the formulæ of scalar and vector products and quotients, the interpretation and transformation of quaternion expressions in general, the differentiation of quaternions, the solution of equations, especially of equations of the first degree, and the analytical theory of quaternions.

But although the works of Hamilton and Tait contain a large mass of material concerning particular quaternion transformations, the general Analytical Theory of Quaternions has yet to be written. A brief outline sketch of a method is given by Cayley in the sixth chapter of Tait's Treatise.

Applications.—It is impossible, in the space permitted to this notice, to do more than name some of the subjects in which the method of quaternions finds its applications. The most important of these to which writers have thus far given attention are the following:

The theory of matrices; orthogonal transformation; geometry of the straight line, of the plane, of the sphere, of the cyclic cone, of surfaces of the second order, of curves and surfaces in general, and of planes in four-dimensional space; kinematics of a point, of a rigid system, and of deformable systems; axes and moments of inertia; statics of a rigid system; kinetics of a rigid system; precession and nutation; the problems of the pendulum; geometrical and physical optics; electrodynamics; the solenoid; applications of the operator, $\nabla = i\frac{d}{dx} + j\frac{d}{dy} + k\frac{d}{dz}$, and of Laplace's

operator ∇^2 , to physical analogies, to line, surface, and volume integrals, to the stress function; application of the ∇ integrals to magnetic problems; the hydrokinetic equations; applications of ∇ in connection with Taylor's theorem and the calculus of variations.

By far the greater portion of extant knowledge of quaternions, both of the theory and of its applications, is due directly to Hamilton and is published in the 'Elements,' but the applications to physical problems were mainly contributed by Tait and are embodied in the twelfth chapter of his 'Treatise.'

History.—The development of the quaternion calculus as an analysis of space relations was the work of Sir William Rowan Hamilton, Andrews Professor of Astronomy in the University of Dublin and Royal Astronomer of Ireland. The effort to create a new calculus of this type was a natural sequence of the many attempts that had been made to interpret geometrically the so-called imaginary and complex algebraic expressions of the forms $a\sqrt{-1}$ and $a+b\sqrt{-1}$. These attempts are recorded in the earlier works whose titles are given in the following bibliography.

Hamilton laid the foundations of the new subject during the years 1833-1843. In November of the latter year his first paper on 'Researches respecting Quaternions' was presented to the Royal Irish Academy. His first full exposition of quaternion theory was published in 1853 in his 'Lectures on Quaternions,' a book of over seven hundred pages.

Meanwhile, in 1844, Grassmann published his now celebrated work, 'Die Ausdehnungslehre,' which occupies common ground with quaternion theory, but plans a much wider range of investigation than was contemplated by Hamilton in his system. The two systems have a common body of fundamental principles, but they have different points of view, different notations, and in part different purposes. Both form the foundations upon which all subsequent work of the kind must stand.

Hamilton's 'Elements of Quaternions,' which still remains the storehouse of knowledge for its subject, was a posthumous work, published in 1866. A new edition has recently appeared in two volumes.

After the work of Hamilton and Grassmann had been finished the next most important forward step in the creation of new algebras was taken by Benjamin Peirce in his essay on 'Linear Associative Algebra,' presented to the National Academy of Sciences at Washington in 1870, subsequently published in the 'American Journal of Mathematics' (1881). In this work the author enumerates the types of linear associative algebras, and classifies them by a set of criteria which takes account of the number and the assumed laws of combination of their irreducible elements (extraordinaries, or vids). These laws are exhibited in the form of a series of multiplication tables.

Some of the more recent attempts to apply the quaternion analysis and the Ausdehnungslehre to physical problems have appeared under the title of 'Vector Analysis,' sometimes with modified, sometimes with wholly changed notations. Of these the contributions of Willard Gibbs and of Heaviside should be mentioned as of special importance.

Bibliography.—The following bibliography, though not exhaustive, enumerates, in strict chronological order, the most important titles of books and monographs that have been published on the subject of quaternions and its closely allied branches. The later dates, where two or more are attached to a single title, are the dates of new editions, or of continuations of a series of papers: Wallis, 'Treatise of Algebra' (1685); Abbé Bueé, 'Mémoire sur les Quantités imaginaire' (read in June, 1805, 'Phil Trans.,' 1806); Argand, 'Essai sur une manière de représenter les

* Tait's 'Treatise on Quaternions' (3d edition, pp. 75 and 289).

† In a foot-note in 'Linear Associative Algebra,' 'American Journal of Mathematics' (vol. 4, 1881, p. 132).

‡ In 'Proceedings of the London Mathematical Society' vol. 4, 1872, pp. 156-159.

§ In Tait's 'Treatise on Quaternions' (3d edition, p. 148), and Cayley's 'Mathematical Papers' (vol. 12, pp. 311-313).

|| In 'Transactions of the American Mathematical Society' (vol. 2, 1901, pp. 186, 187). See also the references to Cayley and Klein on page 184 of this volume, and 'Compte Rendu du deuxième Congrès International des Mathématiciens' (Paris, 1900, p. 336).

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quantités imaginaires dans les constructions géométriques' (1806); Français, 'Papers on the Interpretation of Imaginaries in Gergonne's Annales' (1813); Gauss, 'Verwendung complexer Grössen für die Geometrie' (1819-1852) (Werke, Band VIII), and 'Theoria Residuorum Biquadraticorum' (1825, 1831) (Werke, Band II); Möbius, 'Der Barycentrische Calcul' (1827); Mourey, 'La vraie Théorie des Quantités Négatives et des Quantités prétendues imaginaires' (1828); Warren, 'Treatise on the Geometrical Representation of the Square Roots of Negative Quantities' (1828); Bellavitis, 'Calcolo delle Equipollenze' (1835); Hamilton, 'Papers in the Royal Irish Academy Transactions' (Vols. XVII, XXI), 'Philosophical Magazine,' etc., on 'Conjugate Functions,' 'Algebraic Couples,' and 'Quaternions' (1835-1843); H. Grassmann, 'Die Ausdehnungslehre' (1844, 1862, 1878); De Morgan, 'Trigonometry and Double Algebra' (1849); O'Brien, 'Symbolic Forms Derived from the Conception of the Translation of a Directed Magnitude' (in 'Phil. Trans.,' 1851); Hamilton, 'Lectures on Quaternions' (1853); Allegrè, 'Essai sur le Calcul des Quaternions' (1862); Hamilton, 'Elements of Quaternions' (1866); Tait, 'Treatise on Quaternions' (1867, 1873, 1890); Hankel, 'Vorlesungen über die complexen Zahlen und ihre Functionen' (1867); Benjamin Peirce, 'Linear Associative Algebra' (1870, 1881); Schlegel, 'System der Raumlehre' (1872); Clifford, 'Preliminary Sketch of Biquaternions,' in 'Proceedings of London Mathematical Society' (1873); Kelland and Tait, 'Introduction to Quaternions' (1873, 1882); Houël, 'Théorie des Quantités complexes' (1874); Laisant, 'Applications mécaniques du Calcul des Quaternions' (1877), and 'Introduction à la Méthode des Quaternions' (1881); Hardy, 'Elements of Quaternions' (1881); Gibbs, 'Elements of Vector Analysis' (1881-1884); Graefe, 'Vorlesungen über die Theorie der Quaternionen' (1883); Buchheim, 'A Memoir on Biquaternions,' in 'American Journal of Mathematics' (1885); Heaviside, 'Vector Analysis,' in 'Reprint of Electrical Papers' (1885-1892); Peano, 'Calcolo geometrico secondo l'Ausdehnungslehre di H. Grassmann' (1888); Hyde, 'The Directional Calculus' (1890); Macfarlane, 'Principles of the Algebra of Physics' (1891), and 'Papers on Space Analysis' (1891-1893); Kraft, 'Abriss des geometrischen Kalküls' (1893); Föppl, 'Vorlesungen über die Maxwell'sche Theorie der Electricität' (1894); Hime, 'Outlines of Quaternions' (1894); Hagen, 'Synopsis der höheren Mathematik' (vol. 2, 1895); Hathaway, 'A Primer of Quaternions' (1896); Macfarlane, 'Vector Analysis and Quaternions,' in 'Higher Mathematics' (1896); McAulay, 'Octonians' (1898); Stringham, 'On the Geometry of Planes in a Parabolic Space of Four Dimensions,' in 'Transactions of American Mathematical Society' (1901); Gibbs and Wilson, 'Vector Analysis' (1901); Hathaway, 'Quaternion Space,' in 'Transactions of American Mathematical Society' (1902); Henrici and Turner, 'Vectors and Rotors' (1903).

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Quatrain, a poetical composition of four verses rhyming alternately, a usual form for epigrams, epitaphs, proverbs, etc.; stanzas of

four verses in a longer piece of poetry are also called quatrains, if each stanza expresses by itself a complete idea.

Quatre-Bras, kâtr-brâ ('four branches'), Belgium, in the province of Brabant; at the intersection of the main roads from Brussels and Charleroi and from Namur to Nivelles; about 20 miles south-southeast of Brussels. It is famous for the battle fought here, 16 June 1815, between the English under Wellington and the French under Ney. It was Napoleon's plan at the opening of the campaign of 1815 to fight the armies of the allies singly, as he felt himself unable to cope with their combined forces. At the head of an army of 129,000 men, supported by 350 guns, he made a rapid march into Belgium, crossing the Sambre almost before the allies were aware of his movements. His army was divided into three corps: the right wing, 48,000 strong, being under Grouchy; the centre, of 28,000 men, under the emperor himself; and the left wing, of 48,000, under Ney. The Prussians and English under Blücher and Wellington lay between the French and Brussels. With the right wing and centre of his army Napoleon furiously attacked the Prussians, who, after a severe struggle, retired upon Wavre 16 June. On the same day Ney attacked Wellington at Quatre-Bras. The English, 32,000 strong, repulsed Ney, and maintained their position, though at a loss of over 5,000 men, including the Duke of Brunswick. The English general, hearing of the retrograde movement of the Prussians, fell back on the 17th on Waterloo, where the decisive battle was fought on the following day.

Quatre-Vingt-Treize, kâtr-vân-trâz ('Ninety-Three'), a work of historical fiction by Victor Hugo, published in 1874. The time is, as the title indicates, 1793. The scene is Vendée, during the civil war. In its style it displays much unevenness, but in its characters, vivid scenes, and tragic catastrophe ranks among the author's best.

Quatrefages de Bréau, Jean Louis Armand de, zhô.i loo-e âr-mân dê kâtr-fâzh dê brâ-ô, French naturalist: b. Berthezène, Gard, France, 10 Feb. 1810; d. Paris, France, 12 Jan. 1892. He was graduated from the University of Strasbourg and in 1832 settled in Toulouse, where he practised medicine and shortly afterward founded the 'Journal de Médecine et de Chirurgie de Toulouse.' In 1838-40 he occupied the chair of zoology at the University of Toulouse and in the latter year removed to Paris, where he made a special study of invertebrates. In 1850 he was appointed professor of natural history at the Lycée Napoléon, Paris, and in 1855 professor of anthropology at the Musée d'Histoire Naturelle, which post he occupied until his death. He was elected to the Academy of Sciences in 1852 and was widely known by his anthropological investigations. He was the first expounder of the doctrine of phlebenterism, and was strongly opposed to Darwin's theories. He was the author of many important works on zoology and anthropology, among which are: 'Considérations sur les caractères zoologiques des rongeurs' (1840); 'De l'Organisation des Animaux sans vertèbres des côtes de la Manche' (1844); 'Recherches sur le Système nerveux, l'Embryogénie, les Organes des Sens, et la Circulation des Annélides' (1844-50); 'Physio-

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logie Comparée, *Metamorphose de l'Homme et des Animaux* (1862); *'Souvenirs d'un Naturaliste'* (1854); *'Histoire Naturelle des Annelés Marins et d'Eau Douce'* (1865); *'Les Polynésiens et leurs Migrations'* (1866); *'La Rochelle et ses Environs'* (1866); *'Rapport sur les Progrès de l'Anthropologie'* (1867); *'Ch. Darwin et ses Précurseurs français'* (1870), an attack on Darwinianism; *'La Race Prussienne'* (1871); *'L'Espèce Humaine'* (1877); *'Nouvelles Études sur la Distribution Géographique des Negritos'* (1882); *'Hommes Fossiles et Hommes Sauvages'* (1884); *'Introduction à l'Étude des Races Humaines'* (1887-9); *'Théories Transformistes'* (1892); a series of papers entitled *'Études sur les Types Inférieurs de l'Embranchement des Annelés'*; and he also contributed a large number of articles to the *'Revue des Deux Mondes'* on the results of his scientific researches along the Atlantic and Mediterranean coasts and throughout Italy and Sicily.

Quatrefoil, *kāt'ér-foil*, in architecture, an opening or a panel divided by cusps or foliations into four leaves, or more correctly the leaf-shaped figure formed by the cusps. It is an ornament which has been supposed to represent the four leaves of a cruciform flower, and is common in the tracery of Gothic windows. Bands of small quatrefoils are much used as ornaments in the perpendicular Gothic style, and sometimes in the decorated.

Quatremère, *kātr-mār*, **Etienne Marc**, French Orientalist: b. Paris, France, 12 July 1782; d. there 18 Sept. 1857. He was educated at the Collège de France, was employed at the Bibliothèque Impériale in 1807, and in 1809 accepted the chair of Greek in the University of Rouen. He was elected to the French Institute in 1815, became professor of Hebrew at the Collège de France in 1819, and in 1838 was made professor of Persian in the School for Living Oriental Languages. He made numerous valuable translations and was author of important geographical and historical works in addition to his work as an Orientalist. He published: *'Recherches Critiques et Historiques sur la Langue et la Littérature de l'Égypte'* (1808); *'Mémoires géographiques et historiques sur l'Égypte'* (1811); *'Mémoire sur Nabatéens'* (1835); *'Histoire des Mongols de la Perse'* (1836); *'Histoire des Sultans Mamelouks'* (1837-45); etc.

Quatremère de Quincy, *dé kān-sē*, **Antoine Chrysostome**, French archæologist and politician: b. Paris, 28 Oct. 1755; d. there 8 Dec. 1849. He was prominent politically under the republic, consulate, empire, and restoration, in 1791 having been deputy to the legislative assembly for Paris. After the dissolution of the assembly, he was 13 months in prison, and after the proscriptions of 1793 he became one of the leaders of the insurrection of 5 Oct. 1795, for which he was condemned to death. He was later acquitted and in 1797 represented the Seine in the council of five hundred, but for his opposition to the revolutionists was banished, 5 Sept. 1797. The consuls recalled him in 1799, and in 1800 he was appointed secretary to the council of the department of the Seine; later was appointed to the class of history and ancient literature in the national institute; was made permanent secretary of the Academy

of Beaux-Arts in 1816, and was editor in that department of the *'Journal des Savants'*; elected professor of archæology at the Royal Library in 1818 and serving as deputy in 1820-1. He wrote: *'Dictionnaire de l'Architecture'* (1786-1825); *'Histoire de la Vie et des Ouvrages de Raphaël'* (1824); *'Canova et ses Ouvrages'* (1834); *'Le Jupiter Olympien, ou l'art de la sculpture antique'* (1814); a treatise on ancient sculpture in ivory and gold; *'Essais sur l'Imitation dans les Beaux-Arts'* (1823); *'Monuments et Ouvrages d'art antique restitués'* (2 vols., 1826-8); *'Histoire de la vie et des Ouvrages des plus célèbres Architectes'* (1836); etc.

Quattrocento, *kwāt-rō-chēn'tō*, in art, a term applied to the characteristic style of the artists of the 14th century; it was hard, rigid, and peculiar in color as well as in form and pose. It was the intermediate stage of that progressive period of art which, commencing with Fra Angelico, reached excellence with Leonardo da Vinci.

Quay, *kwā*, **Matthew Stanley**, American politician: b. Dillsburg, York County, Pa., 30 Sept. 1833; d. Beaver, Pa., 28 May 1904. He was graduated from Jefferson College in 1850, studied law, was admitted to the bar in 1854, and elected prothonotary of Beaver County in 1856 and 1859. During the Civil War he was in active service as colonel of the 134th Pennsylvania regiment, being present at the battle of Fredericksburg; he was also assistant commissary general of Pennsylvania, State military agent at Washington, and military secretary to the governor. In 1865-7 he was a member of the Pennsylvania legislature; in 1872-8, and again in 1879-82, he was State secretary; recorder for the city of Philadelphia in 1878-9; and State treasurer in 1885. As early as 1869 he was secretary of the executive committee of the Republican State committee, and after that became the undisputed leader of his party in Pennsylvania. In national politics he was a member of the Republican national committee after 1885, and in 1888 was its chairman, conducting a successful Presidential campaign. In 1887 he was elected United States Senator, serving continuously till 1899; in that year a deadlock in the legislature prevented his re-election. This was in part owing to the fact that in 1898, on the failure of the People's Bank where State funds were deposited, he had been accused of being party to a conspiracy for the misappropriation of public funds; the trial occurred in April 1899, and resulted in his acquittal. He was then appointed Senator *ad interim* by the governor, and elected to the Senate in 1901 for the term expiring in 1905. In the Senate he was one of the strongest opponents of the Panama Canal. His power as a political organizer lay chiefly in his adroit methods of reconciling opposing factions and hostile interests. A striking example of this was his method of meeting the reform movement of 1902 by supporting as candidates for governor of the State and mayor of Philadelphia, men who were endorsed by the reformers and not prominent in the regular Republican organization, thus gaining the support of what might have been a dangerous opposition.

Quay, a landing-place along a line of coast or a river bank, or round a harbor. They

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are usually constructed of stone, but sometimes of wood and iron. See WHARF.

Quayle, kwāl, **William Alfred**, American Methodist clergyman and author: b. Missouri 1860. He was graduated from Baker University, Baldwin, Kan., in 1885, was ordained to the Methodist ministry the next year and has since held prominent pastorates in Kansas City and Indianapolis. He was professor of Greek at Baker University 1885-90, and president of that institution 1890-2. He has lectured widely and has published: 'The Poet's Poet and Other Essays' (1897); 'A Hero and Some Other Folk' (1900); 'The Blessed Life' (1901); 'The Gentleman in Literature' (1902); etc.

Quebec, kwē-běk (Fr. ké-běk), is one of the provinces of Canada, the second in rank, in British North America. Its capital is the city of Quebec.

Boundaries and Extent.—It is bounded on the north by Labrador and Hudson Bay, on the east by Labrador and the Gulf of Saint Lawrence, on the south by the Bay of Chaleurs, New Brunswick, and the States of Maine, New Hampshire, Vermont, and New York, and on the southwest by the River Ottawa, Lake Temiskaming, and the province of Ontario. Its length is nearly 1,000 miles on a due east and west course, its breadth is 300 miles, and its area 351,873 square miles. The surface of the country is varied and very picturesque, embracing several ranges of mountains and lofty hills, diversified by numerous rivers, lakes and forests.

Mountains.—The Notre-Dame, or Green, Mountains, a continuation of the Appalachian Range, extend along nearly the whole of the south side of the Saint Lawrence. That chain runs more or less far from the river, and, after crossing the frontier and the State of Vermont, joins the Alleghanies. The Laurentian Mountains skirt the northern bank of the same river and the Ottawa, somewhere near, and somewhere at a distance of 10, 15, or 30 miles from the banks, but 130 miles west of Montreal cross the Ottawa and curve in the direction of Kingston, whence they run westward to the shores of Lakes Superior and Huron.

Rivers, Lakes, and Islands.—Quebec abounds in large rivers, bays, and lakes. The Saint Lawrence, navigable for ships of over 5,000 tons as far as Montreal, flows through almost the entire length of the province, receiving, a short distance above Montreal, the waters of the Ottawa, a river 600 miles in length. That last river is more abundant in water than the Nile and the Rhine, and has large tributaries, the rivers Gatineau and Lièvre (Hare), which are over 200 miles long, and three others extending over 100 miles to the north. The Saint-Maurice, which rises in Lake Oskelaneo and empties into the Saint Lawrence at Three Rivers, is over 400 miles in length and is remarkable by its enormous flow of water and its falls. The principal, named Shawenegan, Grand 'Mère, La Tuque, Les Piles, are wonderful water-powers. Large pulp mills and paper factories have been erected at Grand 'Mère and at Shawenegan, a few years ago, and are now the centre of towns numbering 5,000 or 6,000 inhabitants. The rivers Batiscan, Sainte Anne, Jacques Cartier, and Montmorency, the last named famous for its falls, also enter the Saint Lawrence from the

north. The Saguenay, rising in Lake Saint John and flowing into the Saint Lawrence at Tadousac, is one of the most remarkable bodies of water in the world, varying in depth from 100 to 1,000 feet. It is the great "exutoire" of the Lake Saint John, in which flow six long rivers; the principal one (the Peribonca) is 400 miles long and navigable for 30 miles. The Richelieu, draining Lake Champlain, discharges into the Saint Lawrence from the south, and so do the Saint Francis, Chaudière, Chateauguay, Yamaska, Etchemin, Bécancour, and from the north, Assumption, Matawan, and du Loup. The largest lakes in the province are: Lake Saint John, with an area of 360 square miles, the Mistassini, the Temiskaming, and the Temiscouata. At three places the Saint Lawrence enlarges and forms lakes, named Saint Francis, the Saint Louis, and the Saint Pierre. The principal islands in the river Saint Lawrence are the islands of Montreal, of Orleans, near Quebec, Anticosti, and the Magdalen Islands, situated in the Gulf of Saint Lawrence, 50 miles north of Prince Edward Island.

Forests.—The province of Quebec is wealthy in forest lands and the numberless rivers and their branches make the handling of lumber extremely easy. The territory on the north side of the Saint Lawrence River is covered with forests which are to all practical purposes valueless owing to the abundance of small growth. Along the River Manicouagan and the Gulf and River Saint Lawrence, the timber is not only of good quality but grows in great quantity, including even scattering pine of value. Extending westward from the Manicouagan to the eastern watershed of the Gatineau, pine of the best quality is found, and lumbering has for a number of years been successfully carried on. In the district from which the Saguenay and its branches draw their waters is a vast quantity of pine, spruce, larch, and other woods. In the district drained by the Saint Maurice and its tributaries pine and spruce are most abundant.

In the Lower Ottawa region, including the vacant and waste lands of the Crown on the northern tributaries of the Lower Ottawa, and embracing the valleys of the rivers Assumption, Dunord, Petite Nation, the Blanche, and du Lièvre, in all 11,256 square miles, are to be found poplar, white and red pine, spruce, tamarack, and birch. In the Upper Ottawa territory is a great pine-growing district, but, while it is more valuable than the forests of the southern part of the province, it has not been worked to the same extent as that part, where the marvelous growth of brown birch, cedar, walnut, maple, and pine has been a valuable source of income. Scattered throughout the province are to be found elm, beech, ash, and cherry trees. The area of the lands on which lumber of merchantable value is to be found (not including that covered by small growth) is 116,521 square miles, of which 31,468 are covered with red and white pine and 85,053 with other woods.

Mines.—The Laurentian formation, which extends through the central portion of the province, holds thick beds of limestone and iron ore, titanite and magnetic, phosphate, plumbagine, mica, and large deposits of graphite. Farther west the Laurentian formation is succeeded by the Potsdam sandstone. On this rests a dolomitic limestone, and the limestone of the Lower

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Silurian Age, known as the Chazy and Trenton groups, are affording the best building stone of the province. There are many other minerals in the province of Quebec; but a few of them only are worked up (exploitees), namely, asbestos, ochre, chrome, copper (near Sherbrooke), lead, silver, and gold in Beauce district. In 1901 there was a remarkable progress and increase manifest in the mining of asbestos throughout the eastern townships in Quebec, and copper also assumed a more important place in the mining industry. The report of the Bureau of Mines for 1900-1 shows that 193 prospecting permits and 12 mining licenses were issued, the greater portion of these going to operators of asbestos mines, who in that year employed 1,500 to 2,000 men, and whose product was valued at \$1,284,424. Pig iron to the extent of 14,449 tons was extracted by the blast furnaces at Radnor and Drummondville. The total value of the minerals extracted in the province was placed at \$1,727,731, including, with asbestos as its largest item, iron ore valued at \$30,978; copper ore at \$126,500; mica at \$39,600; ochre (calcined) at \$14,595; cement at \$28,000; and granite at \$146,000. The mining industry employed 2,792 workmen, whose wages amounted to \$865,110.

Climate.—The cold in Quebec in winter is generally steady; the thermometer often registers 20 degrees below zero, and the snow, falling to a great depth, lies on the ground from November until April. The extreme heat of summer, which is generally warm and pleasant, is indicated at 90°. But it is only exceptional that it runs up to that figure. Autumn, which lasts six or eight weeks, is the finest season of the year.

Agriculture.—Vegetation develops rapidly; there is a rich and loamy soil in much of the country. In the large valleys of the Saint Lawrence, of the Ottawa River, of the Matapedia, of the Richelieu, in the whole region of Lake Saint John, and in the eastern townships of the province, farming is the chief industry. The principal crops are wheat, barley, oats, rye, peas, buckwheat, potatoes, clover, hay, and corn. The lands lying in the vicinity of the State of Vermont are given to stock raising to a greater extent than to farming, and dairying has become an important branch of the trade of that district. As stated in the report of the minister of agriculture in Quebec, 1 Feb. 1902, the conditions have rapidly advanced and improved. The success of the plan of granting government premiums to cheese factories has been assured, up to that time over \$5,000 having been spent in pursuance of that policy, and now the products of such farms form a large part of the income of the farmer. In 1901 there were 1,207 cheese factories, 445 butter factories, and 340 factories of cheese and butter—the products of which having a total value of \$12,874,367. In the stock-raising districts horse and cattle breeding has assumed the most important position, while sheep and swine are also raised to a great extent; the value of the horses, cattle, sheep, and swine in the province in 1902 was \$2,413,416.

Fisheries.—The total yield and value of the fisheries of the province in the same year was \$2,174,459, salmon and cod making up more than half of this total. The number of vessels en-

gaged in the fisheries in 1901 was 786, having a tonnage of 25,605, and manned by 6,214 men.

Trade and Commerce.—The value of the imports entered for home consumption by the province in 1903 was \$93,183,449, and the value of the goods exported from the province in the same year was \$105,841,034. There are 183 banks (including branches) in the province, and a clearing-house at Montreal with annual transactions in 1903 of \$1,113,894,113. There are also 160 post-office savings banks in the province. There were, in 1903, 3,492 miles of steam railway and 178 miles of electric railway in operation in the province. The value of Quebec's mineral production in 1901 was \$3,761,639. The receipts of the province in 1903 were \$4,699,773, and its expenditures \$4,596,061, of which \$418,536 was used for charities and \$455,185 for public instruction. There are published in Quebec 15 daily newspapers, and 180 periodicals of other descriptions, or one for every 8,355 of population.

Education.—Educational matters in the province of Quebec are under the control of a superintendent of public instruction, assisted by a council consisting of 35 members, and divided into committees for the management of Roman Catholic and Protestant schools, respectively. Compulsory school age is from 5 to 16 years. The schools are maintained partly by local taxation and partly by government grants, and are individually controlled by local boards. There are in the province 5,379 elementary schools, 568 model schools, 1,781 academies, 3 normal schools, 19 classical colleges, 4 universities, 4 institutions for blind and deaf mutes, and 8 schools of arts and manufactures. Chief among the higher institutions of learning are Laval University at Quebec, and McGill University and the Presbyterian College at Montreal. There are also in the province 5 industrial and the same number of reformatory schools.

Government.—The system of government established in Canada under the Union Act of 1867 is a federal union having a general or central government controlling matters essential to the general development, the permanency, and the union of the whole Dominion, and a number of provincial organizations, each governed by a lieutenant-governor, nominated and removable by the government of the Dominion, and advised by a council responsible to the people's representatives, and with a legislature composed in Quebec of two houses—a council appointed by the Crown, and an elective assembly. The Parliament of Canada consists of a Senate and a House of Commons. The Senate, as at present constituted, has 81 members, 24 of whom are from Quebec. The House of Commons consists at present of 213 members, the basis of representation, fixed under the provisions of the Act of Confederation, being that the province of Quebec is always to have 65 representatives, and each of the other provinces such a number as will give the same proportion of representatives to its population as the number 65 bears to the population of Quebec as ascertained by a decennial census. In the province of Quebec the qualifications for the electoral franchise are ownership or occupancy of real property, position as teachers or clergymen after five months' domicile in electoral dis-

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trict; income or personal property of specified amount—real, or real and personal, valued at \$300, \$200, and \$100 (fishermen). Income, rentiers, \$100; others, \$300. Absentees in the United States may vote if they have returned with their families and have resided in an electoral district one month before election. Voting in elections is by ballot. No property qualification is demanded from a member of the Commons, nor is he limited to a residence in the district for which he is elected.

Municipal Institutions.—The municipal organization of the province comprises townships, counties, being rural districts of no definite area, parishes, villages with a population of over 40 families, towns, and cities erected by legislative authority. No definite figure of population is requested. The townships, parishes, towns, and villages are administered by a mayor and councilors; the cities by a mayor, councilors, and aldermen.

Judiciary.—The judiciary of the province consists of appeal (King's Bench), superior, circuit, and district courts. The superior court and King's Bench judges are appointed by the governor-general in council. Appeal can be had from superior courts to King's Bench, and from King's Bench to the supreme court of Canada, presided over by a chief justice and five associate judges. Final appeal, except in criminal cases, lies, by leave, to the judicial committee of the privy council of England. Police magistrates and justices of the peace, appointed by the provincial government, also have their place in the administration of justice.

Crown Lands.—The crown lands of the province not yet settled form an area of nearly 200,000,000 acres, of which about 6,625,000 acres have been surveyed, and are controlled by the government and administered by the minister of crown lands. They are sold at from 20 to 60 cents an acre, and the purchaser is required to take possession of the land within six months of the date of the sale, to occupy it during two years, and to fulfil various other obligations stipulated in the deed of sale.

Population.—The population of the province in 1903 was 1,682,682, of whom 477,687 dwelt in towns of more than 4,000 in 1901. The number of families in the same year was 307,304. Roman Catholics comprised the greater part of the population, in 1901 numbering 1,429,260, of whom 1,322,115 are French Canadians. The numerous churches, colleges, and convents of the province attest at every turn the wealth and power of the Church, and the tourist finds the whole land practically parceled out among its faithful, as far as concerns the nomenclature of the settlements and villages.

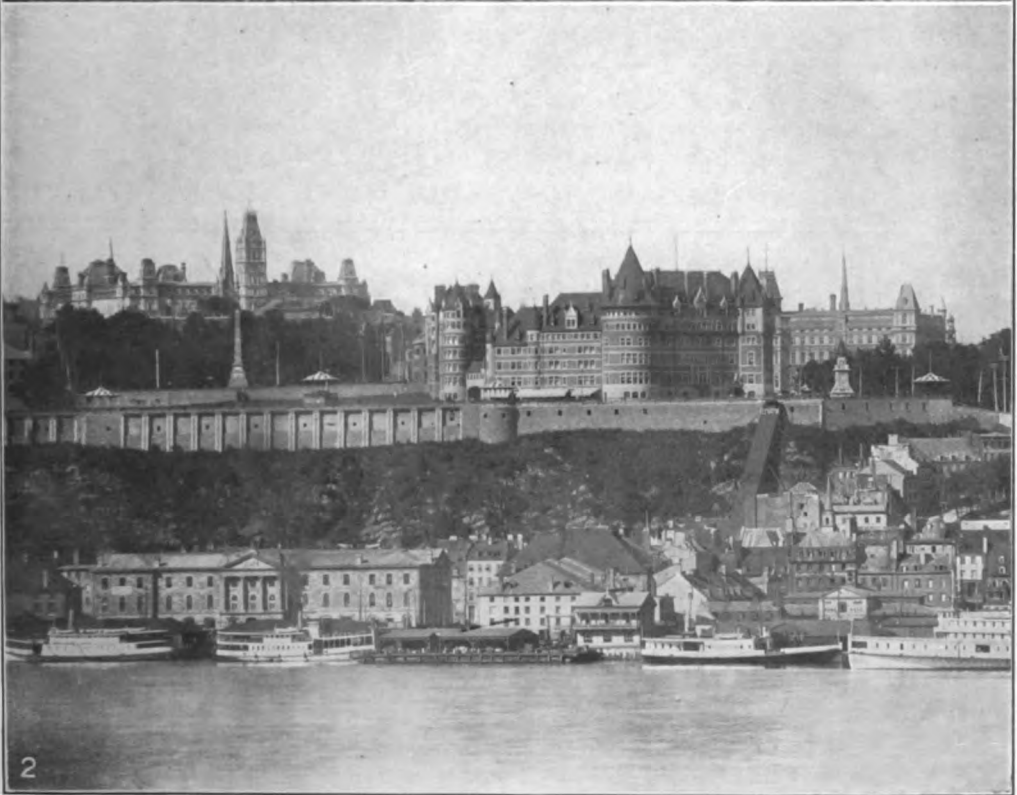
Twenty miles east of the city of Quebec, on the banks of the Saint Lawrence, is the church of Sainte Anne de Beaupré, more particularly known as La Bonne Sainte Anne, who for two centuries has won fame in Canada for miraculous cures. This historic place rests on a little plateau under the shelter of a lofty mountain of the Laurentides, and consists of a straggling street of wooden houses, with steep roofs and projecting eaves. Here one will see, on the fête of Sainte Anne and at other fixed times, a mass of people from every part of Canada, as well as from the United States. A handsome gray stone church attests the faith of the thou-

sands who in past years have offered their supplications at the shrine of La Bonne Sainte Anne. Piles of crutches are deposited in every available corner, as so many votive offerings from the countless cripples who have been cured or relieved. The relic through which all the cures are said to be effected consists of a part of the finger-bone of Sainte Anne, which was sent in 1668 by the Chapter of Carcassonne to Monseigneur de Laval.

The Country Life.—The situation of many of the villages of Quebec is exceedingly picturesque when they nestle in some nook by the side of river or bay, or overlook from some hill a noble panorama of land and water. The spire of the stone church rises generally from the midst of the houses, always making the most conspicuous object in the surrounding landscape. The houses are, for the most part, built of wood. The roofs are often curved, with projecting eaves, which afford a sort of verande, under which the family sit in summer evenings. Some of the more pretentious structures, especially the inns, have balconies running across the upper story. Many of the barns and outhouses have thatched roofs, which are never seen in any other part of Canada. The interiors are very plainly furnished, in many cases with chairs and tables of native manufacture. A high iron stove is the most important feature of every dwelling in a country where the cold of winter is so extreme. Whitewash is freely used inside and outside, and there is, on the whole, an air of cleanliness and comfort in the humblest cottage. No class of the population of Canada is more orderly or less disposed to crime. Early marriages have always been encouraged by the priests, and large families are the rule in the villages. The temperate habits of the people make them valuable employees in mills and manufactories of all kinds, and until a recent period there was a steady exodus from the province to the manufacturing towns of New England. A large proportion of the men employed in the lumbering industry of Canada is also drawn from the province of Quebec. In commercial and financial enterprises, however, the French Canadians cannot compete with their fellow citizens of British origin, who practically control the great commercial undertakings and banking institutions of Quebec, especially in Montreal. But they are remarkably progressing in that line. Nor, as a rule, could they compare formerly with the English population as agriculturists. But they have largely improved their methods of farming, and they have established in every parish butter and cheese factories. The French population also had less enterprise and less disposition to innovations. But they do adopt new machines and improved agricultural implements like the people of the other provinces of Canada.

Literature.—In times past there was no native literature, and little general culture, except in small select circles at Quebec and at Montreal; but during the past half-century, with the increase of population, the establishment of colleges and universities, the dissemination throughout of classical education, and the development of self-government, the French Canadians have created for themselves a literature which shows that they inherit much of the spirituality and brilliancy of their race. The histories and

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1. St. Louis Gate and the Grand Allée.

2. The Chateaux Frontenac, from Levis.

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poems have attracted much attention in France, and some of their literary works have been awarded prizes by the French Academy. In history mention should be made of the names Garneau, Ferland, Sulte, Tassé, Turcotte, Dionne, Casgrain, Gosselin, Le Moine, Gagnon, Myrand, etc.; in poetry, Cremazie, Chauveau, Frechette, Poisson, Lemay, Chapman, and many others; in science, Hamel, Laflamme, De Foville, etc. In art some progress has been made, and young men go to the Paris schools from time to time. The only sculptor of original merit that Canada has yet produced is Hébert, a native of Quebec, whose statues of eminent Canadians stand in several places. Science has not made as much progress as belles-lettres and history, though Laval University has among its professors men who have done creditable work in mathematics, geology, chemistry, and physics. In romance, however, little has been done, except by Marmette, Lemay, and a few others.

History.—Jacques Cartier discovered and explored the Saint Lawrence in 1535, but it was not until 1608 that Samuel de Champlain founded the present city of Quebec, which, at the end of 12 years, had a population of only 60 persons. The Recollets were the first missionaries. The Jesuits came to the settlement in 1634, and thereafter played a leading part in its history. Montreal was founded in 1642 by Maisonneuve; but for many years as an agricultural or commercial settlement New France, as it was called, remained a failure, its only trade being the fur trade. A change came under Louis XIV., when a systematic effort began to make the colony the starting point of a French and Catholic empire which should embrace the whole of the continent. The result of this policy was a century-long contest between the two races, which began in 1689 with the second advent of Count de Frontenac as governor of New France, and ended in 1759 with the capture of Quebec by a British army under Wolfe. The capitulation of Montreal in 1760 completed the English conquest of Canada, which, with all its dependencies, was in 1763 formally ceded to the British crown.

The policy of the conquerors toward New France was, from the appointment of Gen. Murray, a liberal one, and in 1774 took definite form in what was known as the Quebec Act, by which the British Parliament assured the French Canadians the free exercise of their religion, the enjoyment of their civil rights, and the protection of their own civil laws and customs. The act also annexed larger territories to the province of Quebec, and provided for a governing council partly composed of Catholics, and for the administration of the criminal laws as in use in England. There was, however, constant strife between the conquering and the conquered race, the object of which was to amalgamate the two races, and to put an end to it Parliament in 1791 divided Canada into two provinces—Lower Canada, or Quebec, for the French, and Upper Canada (now Ontario) for the British, many of whom had fled thence from the United States at the close of the Revolutionary War. Each province was to have, besides the governor who represented the Crown, a legislative council nominated by the Crown, and an assembly elected by the people for four years. But the two races were not separated by the division of the

province, and in 1841, after a long and stormy agitation, a reunion of the provinces was effected under the name of the Province of Canada, and with it the establishment of responsible government. The legislature consisted of a council and assembly, each province being represented in the assembly by 42 members, 84 in all, elected by the people; and the council numbered 20 members, appointed by the Crown. This arrangement lasted until 1867, when it gave way to a union of the provinces of British North America. The way for confederation was cleared by a convention of representatives of all the provinces, held in Quebec, in October 1864, which unanimously adopted a set of resolutions embodying the conditions on which the provinces, through their delegates, agreed to a federal union. These resolutions were duly laid before the various legislatures and adopted in the shape of addresses to the Queen, whose sanction was necessary to embody the wishes of the provinces in an imperial statute; and in February 1867 the British North America Act was passed by Parliament. On 1 July of the same year the union of the provinces of Canada, Nova Scotia, and New Brunswick was proclaimed under the name of the Dominion of Canada, the names of Upper and Lower Canada being changed at the same time to Ontario and Quebec.

Consult: Parkman, 'France and England in North America'; Kingsford, 'History of Canada'; Smith, 'Canada and the Canadian Question'; Garneau, 'History of Canada'; and Turcotte, 'Le Canada sous l'Union.'

A. B. ROUTHIER,
Chief Justice Superior Court for the Province of Quebec.

Quebec, founded by Samuel Champlain in 1608, is the seat of the Provincial Government. It is situated on the northeastern end of a narrow promontory, which is bounded to the southward by the River Saint Lawrence, and to the northward by the valley of the St. Charles. The cliffs on the St. Lawrence side run up the river for many miles, and average between 200 and 300 feet in height. The earliest buildings were constructed along the narrow shore at the foot of Cape Diamond, and gradually extended to what is now the Lower Town. In the course of time Champlain transferred his residence to the summit of the rock, and soon other buildings arose which marked the beginnings of the Upper Town. In a few places in the Lower Town a part of the river bed has been reclaimed, particularly near the old palace of the Intendants; but with these exceptions the streets follow the original plan. Winding roads, cut out of the rock, and flights of steps, lead from the Lower to the Upper Town, the streets of which bear the names originally given to them. Quebec claims the distinction of being the one walled city of the north, and although the march of progress has introduced many innovations, it has been powerless to destroy the impress of the founder. At the time of the death of Champlain, in 1635, the entire population of Quebec was only 80 persons. But shortly after, as a result of the circulation of the "Relations" of the Jesuits in the mother country, an effort was made to colonize New France. The first fruits of this movement were the establishment of the Ursuline Convent and the Hotel Dieu, in 1639.

QUEBEC

These two institutions, which have ever since exercised a beneficent influence, were founded by the zeal of two noble women, Madame de la Peltrie, and Madame d'Aiguillon, whose names are consecrated in the pages of Canadian history. The Ursuline Convent has continued to be the centre of education for the girls of Quebec, both French and English. In this institution, the Old World and the New run side by side. The rule of the order is the same as in 1639. In the nave of the convent chapel repose the remains of the Marquis de Montcalm; and in the Chapel of the Saints, through all the startling changes of two centuries, the Votive Lamp, first trimmed by Marie Repentigny in the days of the French régime, is still kept steadfastly burning. The Seminary of Quebec, founded in 1668, is another institution in which the customs of the Old World are preserved. From the seminary sprang the famous Laval University, the chief seat of learning in the province for the French population.

From the earliest times Quebec has been fortified. In 1535, Jacques Cartier built a rude fort at the mouth of the river Lairet, and in 1608 the "Habitation" constructed near the site of the present Champlain Market, was mounted with cannon to protect the inhabitants against the incursions of the Indians. Twenty years after a fort was erected on the crest of the rock, which served as a residence for the invader Kertk until 1632. Frontenac put into execution the first scheme for enclosing the town with a wall, but like all the French works of defense, the profit of the contractor was of more importance than the solidity of the workmanship. In 1720, a new scheme was undertaken. Large sums of money were expended from year to year, but when Wolfe came before Quebec in 1759, the foot of rotten walls could be seen 500 yards off. After the battle of the Plains, temporary works were constructed in front of the old walls. In 1783 a temporary citadel was commenced beyond the line of fortification, and the remains of these works, still visible, are erroneously referred to in local guide books and maps, as of French origin. In 1823 the British Government undertook a comprehensive scheme of defense, the main parts of which are in excellent repair to-day. The picturesque old gates have been demolished, and in two instances, arches in keeping with the walls, have replaced them, and the Martello Towers, overlooking the Plains of Abraham, stand as originally built. The Fortress of Quebec comprises the citadel on Cape Diamond, where the governor general's quarters are situated, the town lines, and the forts on Levis Heights. The citadel is garrisoned by the Royal Canadian Artillery.

Quebec has nine parish churches belonging to the Catholics, four others in the charge of chaplains, and thirteen chapels attached to religious communities, open to the public. The Church of England is represented by the English Cathedral, and six churches, while the Methodists, the Presbyterians, and the Baptists, have each separate places of worship. The first parish church was erected in 1633 under the name of Notre Dame de la Recouvrance; but it was destroyed in 1640. In 1647 the French Cathedral was commenced under the name of Notre Dame de la Paix, in commem-

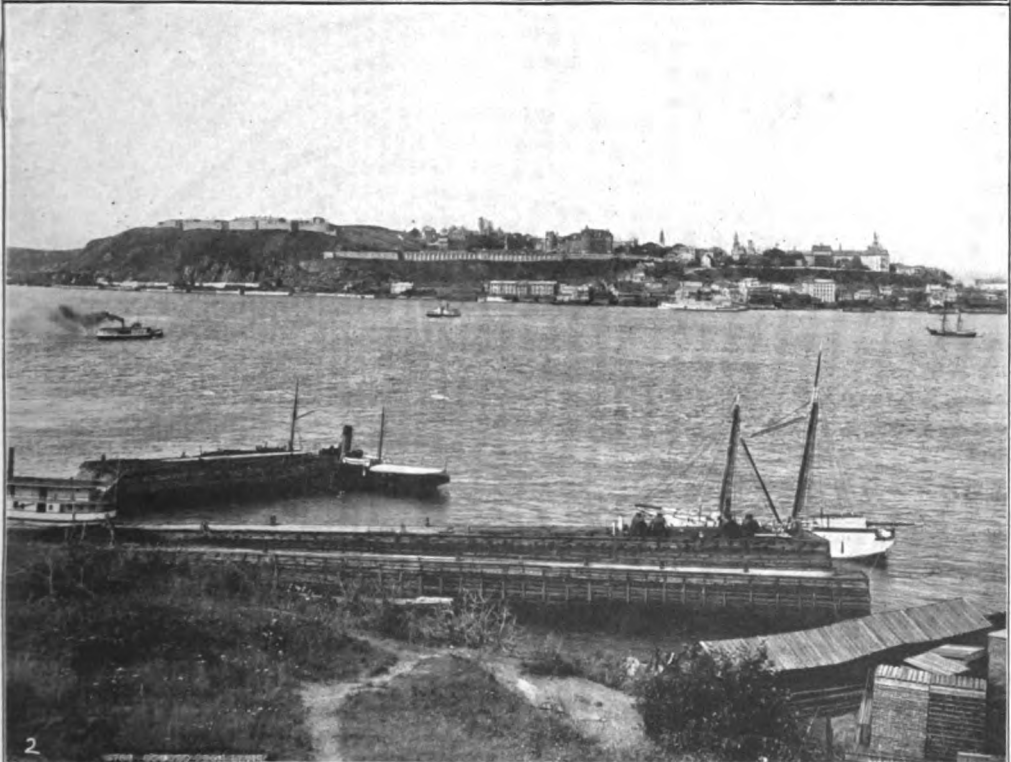
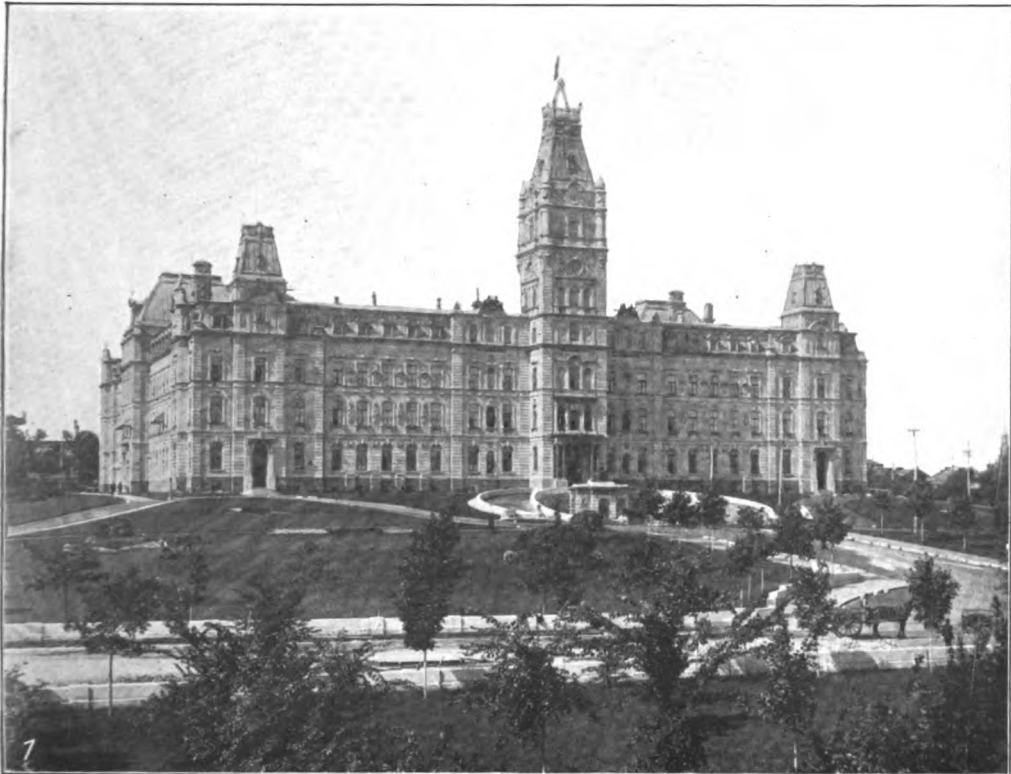
oration of the peace concluded with the Iroquois. It was opened in 1650. The pillars of the present church date from 1647, the Towers from 1684, and the remainder of the building from 1745. The paintings in the Cathedral, brought from France, are very valuable, and there are many costly vestments of an early date. Notre Dame des Victoires, in the Lower Town, was commenced in 1688 under the name of Notre Dame de la Victoire. After Phips besieged Quebec in 1690, a pilgrimage to the church was organized, and in 1711, on the destruction of Walker's fleet off Egg Island, the name of Notre Dame de la Victoire was changed to Notre Dame des Victoires. During the siege of Quebec in 1759, only the walls were left standing. Of the modern Catholic churches the Franciscan's is the most beautiful. It was built for the perpetual adoration of the Blessed Sacrament.

After the Treaty of Paris in 1763, English services were held by the Protestants in the Church of the Recollets. The drum was beaten at half past ten for the Mass of the Recollets, at the conclusion of which the fathers tolled the bell for the English service. The English Cathedral, situated on the site of the Recollet Church, was commenced in 1804. The paintings in the Archbishop's Palace, and in the Ursuline Convent and Laval University, are amongst the most valuable in Canada. In the Governor's Garden is a monument which always appeals to strangers. It is a plain granite column. On one side it bears the name of Wolfe, and on the other the name of Montcalm," and on the base this simple inscription:

Mortem virtus communem
Famam Historia
Monumentum Posteritas
Dedit.

It is the only instance on this continent of a common monument to the victor and the vanquished. Near the jail is the monument to Wolfe, with its inscription "Here Died Wolfe Victorious," and a little farther on, along the Ste. Foy Road, is the column to the memory of the French who fell in their endeavor to retake Quebec in 1760. The name of the English general, Murray, is also prominent on this column. These monuments of stone are more eloquent than words of the harmony existing between two races, mingling with each other, and still preserving their own laws, their language and their religion. In the Upper and Lower Town markets may be witnessed scenes typical of French Canadian habitant life, and even in the streets through which the electric cars run we may trace, at all times, the features of the French régime. The boys of the Seminary still wear the long blue coat piped with white, with green sashes, as they did 200 years ago. The nuns passing to and fro in their prescribed costumes; the priests in their cassocks, the habitants in their old-fashioned vehicles or rude sleighs, look out of place in the 20th century; and yet the people of Quebec would not welcome any change. The city, however, keeps pace with the times in other respects. The streets are well paved, well lighted, always clean. All the waste places possible are converted into small gardens, and there is an excellent civic administration. The hotel accom-

QUEBEC, CANADA



1. Parliament Buildings,

2. City of Quebec from Levis

QUEBEC ACT — QUEEN ADELAIDE ARCHIPELAGO

modation, especially since the construction of the Chateau Frontenac, is the best in Canada. The Parliament buildings and grounds, the city-hall, the court-house and other public buildings, are better than in the larger cities of Canada, and yet there is still so much which belongs to a by-gone age. According to the census of 1901, the population of Quebec is 68,840, a very large proportion of which is composed of French.

Most of the English reside in the Upper Town, although there is no marked division. The Grande Allée is the principal thoroughfare, and contains many fine dwellings. At one time the lumber trade flourished, and as large fortunes were amassed the wealthy merchants and traders built country seats along the Sillery Road; but they are now mostly deserted. Ship building was also a great industry for many years, as very large vessels were built there, but nothing now remains. The leather and shoe trade still give employment to thousands. The commercial and financial institutions are controlled to a large extent by the English. The Lower Town is principally devoted to business, and the suburbs of Saint Roch and Saint Sauveur to manufacture and the dwellings of the working classes. The small arms and the ammunition for the militia are manufactured in Quebec. The port of Quebec is always active in season, but Montreal has absorbed a great deal of the commerce. The bridge which is being built across the Saint Lawrence will bring the grain from all quarters to Quebec, and its future commercial life may assume large proportions. As the seat of government, it will always retain a prominent place, and in its immediate vicinity there are so many places of picturesque and historic interest: Wolfe's Cove; the place where the gallant Montgomery fell in 1775; the Heights of Levis; the Island of Orleans; the Village of Beauport, with Montcalm's headquarters; Indian Lorette; the Falls of Montmorency, with Wolfe's House; the Shrine of Ste. Anne, and the numerous places which may be reached by the C. P. R., the G. T. R., the Intercolonial Ry., the Great Northern, the Quebec and Lake Saint John, and the boats of the Richelieu and Ontario Navigation Co. But the perpetual charm of Quebec, apart from its magnificent situation, lies in the fact that it is the cradle of New France; that upon its lofty rock a drama was fought which decided the fate of a continent; that from its institutions, scarcely altered by the flight of three centuries, men went forth to rescue for civilization an untamed wilderness, and paved the way for the great Republic of the United States.

A. G. DOUGHTY,

Author of 'Quebec Under Two Flags.'

Quebec Act, the administrative measure passed by the British Parliament in 1774, for the purpose of adding the regions extending to the Ohio and Mississippi over which the French had exercised authority, to the province of Quebec, which had been limited by the Proclamation of 1763 to an area of about 100,000 square miles along the central Saint Lawrence. The Act established also the body of the French customary law as the permanent civil code of the region, the introduction of English civil law among the

French-speaking inhabitants having been found impracticable; it admitted also to a partial franchise the Roman Catholic population, guaranteeing them freedom of public worship, confirming them in the possession of their ancient churches and revenues, but withholding from them representative institutions, authority over this vast territory being vested in a council appointed by the executive power of Great Britain.

The Act, which had for its main motives the welfare of the French Canadians and the security and unhampered progress of the colonies and of colonial trade, was viewed with indifference by the Canadians, was unpopular in England, aroused the indignation of the older American colonies, and had considerable influence in directing the early course of the Revolution. To it the Declaration of Independence refers as follows:

"Abolishing the free system of English laws in a neighboring province, establishing therein an arbitrary government, and enlarging its boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule in these colonies." For opposing views on the measure, consult: Coffin, 'The Quebec Act and the American Revolution' in *The Yale Review* (1895); and Bancroft, 'History of the United States,' Vol. IV., chap. v. (1884).

Quebec, Battle of. See COLONIAL WARS IN AMERICA.

Quebracho, kě-brā'chō, the name given to several trees of different genera, but with similar qualities, indigenous to South America, valuable alike for their wood and their bark. The red quebracho (*Loxopterygium lorentii*, family *Anacardiaceæ*) is very hard, but splits easily. The bark and wood are used in tanning. The white quebracho (*Aspidosperma quebracho*) is used for wood-engraving. Its bark contains an alkaloid (quebrachin) and is used therapeutically as a remedy for asthma, being employed as a decoction and a tincture. Its action is to lower the action of the heart without harmful result.

Quechua, kā'chwa. See QUICHUA.

Quedah, kā'dā, or **Kedah**, Malay Peninsula, on the west coast of the peninsula, but belonging to Siam. It is bounded on the south by the British province of Wellesley and the province of Perak. Area, 3,600 square miles. Pop. about 32,500.

Queen, the wife of a king, or the female sovereign of a kingdom. In Britain she is either merely a queen-consort, the king's wife, and his subject, not his equal, on an equal footing, save as provided by law, with the rest of his subjects; or she is a *queen-regent*, regnant, or sovereign, holding the crown in her own right, as did Elizabeth or Victoria. The *queen-dowager*, widow of the king, retains most of the privileges pertaining to a queen-consort. It is high treason to compass or imagine the death of a queen-consort, or to violate her person; and if the consort is consenting, she is equally guilty. Under the constitution of Prussia, Sweden, Belgium, and other European countries a woman cannot be queen-regent.

Queen Adelaide Archipelago, belonging to Chile, at the west entrance to the Strait of Magellan; separated from the mainland by Smyth Channel. The islands are mountainous and present rugged faces to the sea. The summits of some are snow-capped during the year:

QUEEN ANNE STYLE—QUEEN'S COLLEGES

but the vegetation at the base is varied and, for a short season luxuriant.

Queen Anne Style. See RENAISSANCE.

Queen Anne's Bounty, a fund established for the enlargement of the incomes of the holders of the poorer incumbencies in the Established Church of England, and to aid incumbents in rebuilding parsonages by granting advances of money. It was created by royal charter of Queen Anne, confirmed by act of the parliament, by which the first fruits (the whole of the first year's profits) of all spiritual preferments, and the tenth part of the annual profits of the same—both of which, prior to the reign of Henry VIII. had been paid into the papal treasury, but were then annexed to the crown—are set aside to form this perpetual fund. The fund is administered by a board of governors consisting of high ecclesiastical dignitaries, the speaker of the house of commons, privy councillors, chancellors of the universities, etc. It amounts to over \$25,000,000, and the annual grants to over \$75,000. To encourage private benefaction, the board of governors may give \$1,000 to incumbencies of not exceeding \$225 a year where an equal or greater sum is voluntarily contributed.

Queen Anne's Pocket-Melon. See MELONS.

Queen Anne's War. See COLONIAL WARS IN AMERICA.

Queen of the Antilles, a name given to the island of Cuba on account of its superior natural advantages.

Queen Charlotte Islands, a group off the coast of Canada, belonging to the Province of British Columbia; about 100 miles from the mainland and 135 miles northwest of Vancouver Island. Area, 5,100 square miles. The largest islands are Graham and Moresby, each about 160 miles long and 70 miles wide. The surface of Graham is rolling land; but the other islands are rugged and mountainous. Dense forests and a luxuriant growth of small plants cover the islands. Copper, anthracite coal, iron ore and gold-bearing quartz are found here; fishing is the chief occupation. The inhabitants are mostly Indians.

Queen Charlotte Sound, the body of water which separates Vancouver Island (q.v.), on the north, from the mainland of Canada. It is the first, on the north, of a series of inlets, or channels, which lie between Vancouver and other islands and the mainland.

Queen City, or **Queen of the West,** names applied to Cincinnati, Ohio, on account of its commercial importance, at a time when it was larger than Chicago and Saint Louis.

Queen City of the Golden Gate, a name given to San Francisco on account of the name of the strait north of the city, and also that the city was practically the gate or entrance to the gold fields of California.

Queen City of the Lakes, a name given to Buffalo, N. Y., on account of its commercial importance and its commanding position on the Great Lakes.

Queen Conch, a large West Indian gastropod (*Cassis cameo*). See CONCH.

Queen of the Eastern Archipelago, the island of Java; so called on account of its salubrious climate, picturesque scenery, and fer-

tile soil. It is the seat of the Netherlands power in the East. See JAVA.

Queen Esther. See MONTOUR, ESTHER.

Queen-of-the-Meadow, or **Quaker-lady,** a *spiræa*. See MEADOW-SWEET.

Queen of the Plains, a name applied to Denver, Colo., which rests on an eminence on the western border of the Great Plain, and seems to overlook the vast region of plain-land stretching off to the east.

Queen's Bench. See COURT.

Queen's College, Cambridge, England, founded in 1448 by Margaret of Anjou, queen of Henry VI., and again in 1465 by Elizabeth, queen of Edward IV., is administered by a president and 13 foundation fellows. A fixed proportion of the revenues of the college is paid to a scholarship fund. There are nine church livings in the gift of the college, and one in that of the president. There are in addition four exhibitions named after their founders, and the president distributes \$650 per annum in grants to deserving students of limited means. The college buildings are among the most interesting in the university, and include four courts of small size. In a tower in the pump-court are the rooms inhabited by Erasmus (1506). John Fisher, Thomas Fuller, and Bishop Pearson were members of the college.

Queen's College, London, England, established for women in 1848, was incorporated by royal charter in 1853. It provides for the higher education of women, first by a liberal school training, and subsequently by a six years' course of college education.

Queen's College, Oxford, England, was founded in 1340 by Robert Eglesfield, chaplain to Philippa, queen of Edward III., for a provost and 12 scholars. The college now consists of a provost, from 14 to 16 fellows, about 25 scholars, and two Bible-clerks. Six of the scholarships, annual value \$400, are called Eglesfield scholarships, and are awarded to natives of Cumberland and Westmoreland. There is also a scholarship called the Jodrell scholarship, of the annual value of \$450 and tenable for four years; and a considerable number of other exhibitions. The college presents to 23 church-livings. The college buildings are of the 17th century; the hall was designed by Sir Christopher Wren. Wyclif, Edward the Black Prince, Henry V., Addison, Bentham, Jeffrey, Mitford and Wycherley are numbered among its distinguished alumni.

Queen's Colleges, Ireland, three in number, are situated at Belfast, Cork, and Galway, and were chartered in 1849 in pursuance of an act of parliament passed in 1845, granting \$500,000 out of the consolidated fund for their establishment. The colleges were opened in 1850, being connected with Queen's University, then also instituted as a degree-conferring body. The corporate body of each college consists of the president and professors, and the general government and administration are vested in a council consisting of the president and six members, elected by the professors from among themselves. The number of students attending during the session of 1901 was 627.

Students of the Queen's Colleges in Ireland may obtain degrees in arts, medicine, and law

QUEEN'S METAL—QUEENSBERRY

from the Royal University of Ireland (q.v.) by observing the course of studies prescribed by that body, and passing the requisite examination. This university was founded in pursuance of the provisions of the University Education (Ireland) Act, 1879, and has now superseded the Queen's University in Ireland.

Queen's Metal. See BRITANNIA METAL.

Queen's Pigeon, a magnificent ground pigeon (*Goura Victoria*), inhabiting the islands of the Indian Ocean, named after Queen Victoria. See GOURA.

Queen's University, Kingston, Canada. The Royal Charter of Queen's University dates back to 1841. In 1838 steps were taken by the Synod of the Presbyterian Church to found a college at Kingston, Ontario, for the training of young men for the learned professions, including the work of the ministry. The beginnings, as usual with colleges, were small. The first classes with ten students were opened in March, 1842, with Dr. Liddell as principal. Funds were provided in part from grants from the Presbyterian Church of Scotland, and from the Canadian government, in part from the liberal subscriptions of friends of the young and growing university. Owing to the lack of good schools in the province, it was found necessary to establish a preparatory school in connection with the college. In spite of straightened circumstances and many obstacles progress was steady, and financial difficulties were overcome by the energy and courage of principal and friends.

Three times have appeals been successfully made to the public for the endowment fund; the first campaign under Principal Snodgrass took place at a time of great depression, and tided the college over a serious crisis. A second appeal was made by his successor, Principal Grant, in 1878-9, with brilliant success, and in 1881 a new building, an enlarged staff, and a great increase of students was the immediate result. Again in 1887 an effort was successfully made to raise the sum of \$250,000, which was called, in honor of the Queen's Jubilee, the Queen's Jubilee Fund. The twenty-five years of Dr. Grant's principship were marked by extraordinary growth and development on every side of college life. Himself a tireless worker and a born leader of men, he succeeded in infusing his own enthusiasm into all around him.

At the time of the Federation of Colleges in Toronto Queen's was urged to join, but the proposal was decidedly negatived by the friends of Queen's, and events have fully justified their decision.

The medical faculty of Queen's was established in 1854. It was reorganized in 1865 as the Royal College of Physicians and Surgeons in affiliation with the university. In 1891 the original status was resumed. The number of students last year enrolled was 216. Queen's led the way in Canada in co-education. As early as 1870 special classes in English and other subjects were formed for women, but the academic career leading to a degree was not thrown open to them till 1878-9. In 1880, co-education was extended to the medical course,

but in 1883 a separate Women's Medical College was opened and affiliated with Queen's. In 1894, similar facilities being offered in Toronto and other places, this college was closed. Meanwhile the extension of Queen's continued. 1891 saw the opening of the Carruthers Science Hall and of the School of Mines, the latter under government support, by whom the splendid building for physics and geology has lately been added. At the time of Principal Grant's death, in 1902, three new buildings were rapidly approaching completion. Since that time a magnificent Convocation Hall has been erected by the students and alumni to his memory. It is called Grant Hall. The group of college buildings at present consists of two arts buildings, with the Grant Hall, the engineering building, the physics and geology building, the Carruthers Science Hall, and the medical building.

The number of students registered in 1903, in all faculties, was about a thousand. Each session tells of increase. The government of the student body is largely carried on by the Alma Mater Society, which was formed in 1859-60. It has its own officers (taken from the students) and regular meetings, and has its official organ in the 'Queen's College Journal,' published entirely by students. The annual alumni conference brings many of the sons of Queen's back for a week's intercourse and renewal of old ties. The library, which is in the main arts building, contains about forty thousand volumes, including many valuable donations and collections. The curriculum of this university includes the following courses: The Arts Course, leading to the degrees of B.A. and M.A., D.Sc., and Ph.D., embraces classical literature, modern and oriental languages, English, history, mental and moral philosophy, political science, mathematics, physics, chemistry, mineralogy, geology, assaying, metallurgy, botany, and animal biology. The Law Course, leading to the degree of LL.B. The Theological Course, leading to the degree of B.D. The Medical Course, leading to the degree of M.D. and C.M. The Science Course, leading to the degree of B.Sc. and M.E.

GEO. Y. CHOWN,
Registrar of the University.

Queensberry, kwēnz'bēr-ī, John Sholto Douglas, 8TH MARQUIS OF, English sporting character: b. England 20 July 1844; d. London 31 Jan. 1900. He served in the navy when a youth, and in the army from 1859 to 1864. His life was marked by much eccentricity. He was one of the founders of the Amateur Athletic Club in 1860, and was a recognized authority on boxing, and part author in 1867 of the prize-ring rules which bear his name. (See PUGILISM.) He sat in the House of Lords as a Scottish representative peer in 1872-80. In 1881 he published 'The Spirit of the Matterhorn,' a meditation in blank verse. He also came into prominence as a supporter of secularism, and as a defender of Charles Bradlaugh (q.v.), in 1882 creating a scene in a London theatre by rising in his seat and denouncing as "an abominable caricature" the imaginary free-thinker in Tennyson's 'Promise of May.' He was instrumental in effecting the imprisonment of Oscar Wilde

QUEENSBERRY — QUEENSLAND

(q.v.) in 1895, by defending the libel action brought against him, on the grounds that what he had published was "justifiable and for the public benefit."

Queensberry, William Douglas, 4TH DUKE OF, British sportsman: b. 1724; d. London, England, 23 Dec. 1810. He was devoted to horse-racing, and was familiarly known as "Old Q." He was vice-admiral of Scotland in 1767-76 and was then first lord of the police until the office was abolished in 1782. He succeeded to the dukedom in 1778 and was created a British peer in 1786. In 1789 he was removed from his office of gentleman of the bedchamber and held no further office. He was notorious for his excesses and was satirized by Robert Burns in 'The Laddies by the Banks o' Nith,' and in an 'Epistle to Mr. Graham of Fintrie.' Wordsworth addressed him in a sonnet as "Degenerate Douglas," and he was the original of the Earl of March in Thackeray's 'Virginians.'

Queensberry Plot, a presumed Scottish Jacobite conspiracy, so called owing to the connivance, in 1703, of the Proto-rebel James Douglas, second duke of Queensberry, with the intrigues of Simon Fraser, Lord Lovat (q.v.), to involve their common enemy, the Duke of Atholl, in a supposed conspiracy against Queen Anne. Atholl discovered the sham plot and revealed it to the queen. Queensberry, who had been a tool of Fraser, was compelled in consequence to resign his offices.

Queens'land, Australia, a state of the Commonwealth, prior to 1901 a colony. It occupies the northeastern portion of the continent, north of New South Wales and South Australia, and east of the latter. The land boundaries are mostly artificial, the meridians of 138° and 141° east, and the parallels of 29° and 26° south; on the east it has the Pacific, on the north the Gulf of Carpentaria. The most northern part of it, forming York Peninsula, extends to Torres Strait, and a considerable portion is within the tropics. It has an area of about 668,497 square miles, and is divided into twelve large districts (besides smaller divisions), namely, Moreton, Darling Downs, Burnett, Port Curtis, Maranoa, Leichhardt, Kennedy, Mitchell, Warrego, Gregory, Burke, and Cook. Besides the capital of the state, Brisbane, the other important towns are Ipswich, Rockhampton, Toowoomba, Townsville, Mackay, Maryborough, Gympie, Bundaberg, Charters Towers, Normanton, Cooktown, and Somerset.

Topography.—A series of parallel ranges of mountains traverses the State from north to south near the coast, among the numerous local names being Cook Range, Razorback Range, Dawes Range, and Glasshouse Mountains. The Dividing and M'Pherson Ranges run from the head of the Dumaresq River in the south eastward to the coast. There is a long range in the interior running east and west, and forming a watershed between rivers flowing north and those flowing south. The peak of highest elevation is Wooroonooran in a spur of the Coast Range known as the Bellenden Ker Range. Its elevation is 5,400 feet. The coast is indented with numerous inlets, bays and harbors, some of the chief being: Moreton Bay, Hervey Bay, Port Curtis, Keppel Bay, Broad Sound, Repulse

Bay, Halifax Bay, Rockingham Bay, Princess Charlotte Bay. Among the numerous islands along the coast are: Stradbroke, Moreton, and Bribie, at Moreton Bay; Fraser or Great Sandy Island, Curtis, Whitsunday, Hinchinbrook, all off the east coast; Prince of Wales, Banks, Thursday, and others in Torres Strait; and the Wellesley Islands, in the Gulf of Carpentaria. Parallel to the east coast, and at no great distance, runs the Great Barrier Reef.

Hydrography.—There are four great river-systems: (1) rivers draining to the Pacific coast, the chief being the Burnett, the Fitzroy, the Burdekin, and the Brisbane, the last entering Moreton Bay, and having Brisbane, the capital, near its mouth; (2) those draining to the Darling, comprising the Macintyre, the Condamine or Balonne, and the Warrego; (3) those draining to the Gulf of Carpentaria, among them being the Flinders, the Leichhardt, the Albert, the Nicholson, the Gilbert, the Mitchell; (4) those flowing into the interior, the chief being the Victoria or Barcoo, which enters Lake Eyre in South Australia as Cooper's Creek, the Herbert, and the Diamantina or Mueller.

Geology and Mineral Resources.—The Cretaceous system is extensively developed in the west and northwest, covering an area of about 200,000 square miles. Tertiary strata occur along the coast of the Gulf of Carpentaria and elsewhere, and occupy a considerable area. The Desert or Eolian Sandstone, which renders extensive tracts barren and almost uninhabitable, is variously classed as Upper Cretaceous or Tertiary. Palæozoic formations also cover a large part of the country, especially along the eastern coast. About 14,000 square miles are Carboniferous, and some 40,000 of Devonian age, and the Cambrian and Silurian also occur. Mesozoic formations older than the Cretaceous are well developed in some places. Granitic rocks are very extensively developed in the east coast districts, and they have been estimated to occupy about 100,000 square miles. More than 30,000 square miles are covered by volcanic rocks. Gold was discovered about 1858, and there are now more than 25 gold-fields in the state, among them being Gympie (near Brisbane), Charters Towers (on the Burdekin), Cape River, Croydon, Cloncurry, and Jordan Creek. The annual production exceeds \$12,500,000. Other minerals of importance are copper, tin, and coal, but antimony, silver, lead, bismuth, manganese, plumbago, asbestos, and precious stones are also obtained. Bluestone, freestone, granite, and other rocks are quarried.

Climate.—The climate is healthful and the temperature comparatively equable. The mean temperature at Brisbane is 69°, the extreme range being from 35° to 106°. In the more northern parts the climate is tropical. The rainfall in the interior is scanty and variable; the mean at Brisbane is about 35 inches. In some parts it is now supplemented by means of artesian wells.

Forestry, Fauna, etc.—The state possesses various kinds of valuable timber, such as the red cedar, the Moreton Bay pine, the cypress pine, and several species of eucalyptus. Some of the grasses are valuable as fodder plants. There are several good indigenous fruits. The animals and plants are similar to those of the rest of

QUEENSTOWN—QUENSTEDT

Australia. Crocodiles are found in some of the northern rivers. Pearl-fishing is extensively carried on in the extreme north, and the bêche-de-mer, dugong, and other fisheries are also of some importance.

Agriculture.—The soil and climate are suited for the production of all the ordinary cereals, as well as maize, tobacco, coffee, sugar, cotton, and other plants. Maize is more generally cultivated than any other cereal crop. The next crop in point of importance is sugar. All kinds of semi-tropical and English fruits are abundantly grown. Sheep-farming is the chief industry, and cattle-breeding is also important.

Commerce, Manufactures, Communications.—The principal imports are apparel and haberdashery, cottons and woollens, flour, iron and steel, boots and shoes, tea, spirits, hardware, machinery, wine, etc.; and the principal exports, wool, gold, tin, sugar, preserved meat, cotton, wood, hides, and skins. The imports come mainly from the United Kingdom and the United States. The value of the total imports in 1901 was about \$31,880,000, of the exports \$46,245,000. A duty of 5 per cent is charged on imports of yarns, woven fabrics, paper, stationery, etc.; and duties at other and even higher rates on other articles.

The manufactures are comparatively unimportant; the chief industrial establishments are sugar-mills, steam saw-mills, soap-works, distilleries, breweries, carriage-works, butter-factories, boot and shoe factories, cordial-factories, etc. There are over 2,800 miles of state-owned railway open. The most important lines are the three which reach the coast at Brisbane, Rockhampton, and Halifax Bay. There are also over 10,240 miles of telegraph lines, and an extending system of telephonic communication; 684 vessels with an aggregate of 853,515 tons entered, and 675 vessels of 832,305 tons cleared the ports of the state in 1901.

Government, Education, and Religion.—The government is vested in a governor, who is the king's representative, an executive council, and a parliament of two houses, the legislative council and the legislative assembly. The council consists of 39 members appointed by the crown for life, and the assembly of 72 members elected by the people for three years, and representing 61 electoral districts. The revenue of the colony exceeds \$20,000,000, and the expenditure is usually less; the debt is about \$170,000,000. Education is free and secular in the state schools. A university is to be established for the state. There is no state church, each religious denomination being entirely self-supporting. Anglicans predominate, with Roman Catholics second.

History.—The first settlement of Queensland took place in 1825, when the territory was used as a place of transportation for convicts, who continued to be sent there till 1839. In 1842 the country was opened to free settlers. It was originally a part of New South Wales, until in December 1859, it was organized as a separate colony under its present name instead of the earlier one of Moreton Bay District. In 1901 it became one of the states of the Australian Commonwealth. Pop. (1891) 393,718; (1901) 503,266. See AUSTRALIA.

Consult: Russell, 'The Genesis of Queensland' (1888); Rutledge, 'Guide to Queensland' (1889); Weedon, 'Queensland Past and Present' (1897).

Queens'town, Ireland, a seaport town and important naval station, in the county and nine miles southwest of Cork, on Great Island, which is situated in Cork harbor, and rises abruptly to a considerable elevation. The streets rise above one another, and present a picturesque appearance. It has a splendid Roman Catholic cathedral. Queenstown is almost solely dependent on its military and naval establishments. It is an important port of call for mail steamers and was formerly known as COVE OF CORK. In honor of Queen Victoria's visit in 1849 the name was changed to Queenstown. Pop. about 8,000.

Queenstown, Ontario, Canada, village and picturesque summer resort of Niagara County, on the Niagara River, near the mouth of the gorge, seven miles below the falls, and opposite Lewiston, N. Y. Pop. 400. The Brock monument, 185 feet high, on the heights overlooking the village, commands a magnificent prospect, and commemorates the battle of 12 Oct. 1812, when Gen. Van Rensselaer commanding 6,000 United States troops near Lewiston, sent about 1,000 men across the river in the night to attack Queenstown preparatory to a further invasion of Canada. General Brock, the capturer of Detroit, commanded the British forces, but was killed early in the action. The rest of the American troops refused to cross the river, and the attacking party, overpowered by numbers, was compelled to surrender. The American loss in killed and wounded was 190, in prisoners 900; the British lost about 130 killed, wounded and prisoners.

Queiroz, kâ-ê-rôs', José Maria Eça de. See EÇA DE QUEIROZ.

Quelpart, kwêl'pärt, Quelpaert, or Tamra, an island off the southern coast of Korea, about 62 miles from the mainland. Tamra is the native name of the island. In form it is nearly oval; area, about 750 square miles. It is mountainous, the highest point, Mount Auckland, or Han-rasan, is 6,650 feet in height. This mountain is an extinct volcano; three well defined craters exist, in each of which is a lake of pure water. One of the traditions held sacred by many of the natives, is that from these lakes came the first three men of the world. The principal town is Chyei Chyu. The chief industries are fishing, agriculture, cattle-raising, and manufacturing fine split-bamboo hats. Pop. 81,000. Consult: Hamel, 'Narrative of Captivity in Korea,' in 'Korea Without and Within' by Griffis; Belcher, 'Narrative of H.M.S. Samarang,' containing an account of the survey and mapping of the island, by the officers of the British ship Samarang.

Quenstedt, kwên'stêt, Friedrich August, German mineralogist and geologist: b. Eisleben, Germany, 9 July 1809; d. Tübingen, Germany, 21 Dec. 1899. He was educated at Berlin and in 1837 became professor of geology and mineralogy at Tübingen where he remained until his death. He made valuable investigations in geology and mineralogy and in the latter science was first to apply the analytic method to the study of crystalline systems. He wrote: 'Methode der Kristallographie' (1840); 'Grundriss der bestimmenden und rechnenden Kristallographie' (1873); etc.

Quentel, kvěn'těl, **Heinrich**, German printer: b. Strasburg; d. 1501. He established a press near the cathedral at Cologne and though the earliest dated work from his press is 'Fratriſ Astexani Opus de Casibus Conscientiæ' (1479) yet the earliest Low German version of the Bible, usually stated 1470, is undoubtedly from his types and probably from his press. The business was conducted in his name for some time after his death.

Quentin Durward, kwěn'tin dēr'ward, a romance by Sir Walter Scott published in 1823. The scene of this tale is France during the reign of Louis XI.; the hero, Quentin Durward, is a Scottish archer, who, having a relative in the Scottish Guards of the French king, goes to France to seek his fortune. The book was written at the flood-tide of Scott's popularity at home; the ebb began with 'St. Ronan's Well,' published six months later.

Quérard, kâ-râr, **Joseph Marie**, French bibliographer: b. Rennes 25 Dec. 1791; d. Paris 3 Dec. 1865. From 1819 to 1824 he was attached to a well known Vienna book firm and while there prepared the first part of his 'La France Littéraire', in which he gives a complete bibliography of France for the 18th and the beginning of the 19th centuries, including not merely notices of French writers, but of foreign authors whose works had been reprinted or translated in France. The whole work appeared in ten volumes (1827-42). Among other works of his are: 'La Littérature Française Contemporaine,' of which Quérard himself prepared only the first two volumes (1839-44); 'Supercheries Littéraires Dévoilées' (1845-56).

Quercia, kwâr'châ, **Jacopo Della**, Italian sculptor: b. Quercia, near Siena, about 1371; d. 1438. He was the first Tuscan sculptor who combined observation of nature with study of the antique and thus reformed plastic art in Italy. His chief works are the sepulchral monument of Ilaria de Caretto in the cathedral at Lucca; a fountain adorned with the Madonna and emblematic figures of the virtues, Faith, Hope, Charity, Prudence, Justice, Temperance and Fortitude, at Siena; a marble font in the cathedral of the same city and the reliefs in the portal of the church of San Petronio at Bologna. Consult: Cornelius, 'Jacopo della Quercia' (1896).

Quer'citron, the internal part of the bark, used as a yellow dyestuff, of the black oak (*Quercus tinctoria* or *Q. velutina*), one of the finest of North American oaks (q.v.). The dye is due to a peculiar chemical principal, quercitrin, and is obtained by using alum or stannic chloride as a mordant. A finer yellow is said to be obtained when the decoction of the bark is previously boiled with dilute hydrochloric acid. In the United States it is used for tanning.

Quer'cus, the generic name for oak (q.v.).

Queres (K'eres, the aboriginal stock name), a group of Pueblo Indian tribes, numbering 3,582 individuals, in seven permanent villages on the Rio Grande and to the westward thereof, in New Mexico. They form the Queres, or Keresan, linguistic family, speaking a distinct stock language. The Indians claim to have had their origin at Shipapu, a mythic place in

the north, from which they gradually drifted southward and occupied, still in prehistoric times, the Rito de los Frijoles, west of the Rio Grande, where they excavated the cavate lodges in the soft volcanic tufa cliffs still to be seen. These were abandoned before the coming of Coronado, in 1540, who found them in seven pueblos (excluding Acoma and probably Sia) forming the province of "Quirix," along the Rio Grande. In 1630 they were reported by Fray Alonzo de Benavides to number 4,000, but this and other early estimates did not include Acoma. (See PUEBLO.) The present Queres pueblos are as follows;

Cochiti (native *Kot'yiti*).—On the west bank of the Rio Grande, 27 miles southwest of Santa Fé. In prehistoric times the natives of Cochiti and San Felipe formed one tribe, but on account of the hostility of the Tewas (see TANOAN INDIANS), they divided, the latter building a village near their present pueblo, the former settling in the Potrero Viejo, which they later abandoned, moving to near their present location, where they were found by Oñate in 1598. The Cochiti villagers were active participants in the Pueblo revolt of 1680, killing their missionary, but continuing to occupy their town. On learning of the approach of the Spaniards to reconquer their town a couple of years later, they fled, with the people of Santo Domingo and San Felipe, to the Potrero Viejo, where they remained almost uninterruptedly until 1692, when they were induced by Vargas to return to their homes. The Cochiti and Santo Domingo people again fled to the Potrero, however, where they were assaulted by Vargas in 1693 and severely defeated, 200 of their women being captured and their pueblo burned. Cochiti became the seat of the mission of San Buenaventura early in the 17th century. Of the 16 clans 4 are extinct. Pop. 300.

San Felipe (native name *Katishtya*).—On the west bank of the Rio Grande, 12 miles above Bernalillo. Formerly combined with the people of Cochiti, but independently occupying the vicinity of the present site at least since 1540. It was the seat of one of the earliest missions of New Mexico, its first church being erected prior to 1607. The inhabitants participated with those of Cochiti and Santo Domingo in the great revolt of 1680, but aided Vargas in dislodging the Cochiteños from the Potrero Viejo in 1693. They had no resident missionary at the time of the revolt, but aided in murdering the priests of Cochiti and Santo Domingo. After leaving the Potrero in 1692 the San Felipe people built a new pueblo on a mesa northwest of their present town, where a church (the walls of which are still standing) was erected in 1694. This was abandoned early in the 18th century and the present pueblo established, the fourth to bear the name *Katishtya*. Of the 30 San Felipe clans 9 are extinct. Pop. 550.

Santo Domingo (native name *Kiwa* or *Diyiwa*).—On the east bank of the Rio Grande, 18 miles above Bernalillo. In prehistoric times the inhabitants occupied successively the Potrero de la Cañada Quemada and two pueblos called Guipuy, in the latter of which, on the Rio Grande, they were found by Oñate in 1598. Like its predecessor, the second Guipuy, as well as Huashpatzena, the settlement which followed, was swept away by flood, and the present Santo

QUERETARO — QUERN

Domingo has had three similar but less severe disasters between its founding in 1692 and 1886, when a freshet destroyed its fine old church with carved doors bearing the Spanish coat of arms. At the time of the Pueblo rebellion of 1680, it was an important mission seat and the residence of the custodian of the province, who, with two other priests, were slain. The pueblo has 18 surviving clans and a population of 670.

Santa Ana (native name *Tamaya*).—On the northern bank of the Rio Jemez, a western tributary of the Rio Grande. Before the Spanish advent the inhabitants lived nearer the Rio Grande and in 1598 resided on a mesa between the present pueblo and San Felipe. They joined the San Felipe and Santo Domingo people in the great revolt, but in 1687 their village was carried by storm and burned, several of the natives perishing. The present town was built after 1692. It became a mission early in the 17th century, but had no resident missionary at the time of the rebellion. Santa Ana has 7 clans and a population of 228.

Sia (native *Tsia*).—On the north bank of Jemez River, 16 miles northwest of Bernalillo. It was formerly a pueblo of great importance, and in 1583 was said by Espejo to be the chief one of five towns forming the province of "Punames." It early became the seat of Nuestra Señora de la Asuncion. Its inhabitants made a most determined stand during the revolt of 1680, but in 1689 they were assaulted by the Spaniards, their pueblo wrecked, and the tribe decimated in the bloodiest engagement of the rebellion. Since this time the little tribe has been declining, its present population being about 125. Sia formerly had 37 clans, but of these only 16 survive.

Acoma (from *Akóme*, "People of the White Rock").—This pueblo and Laguna from the western division of the Queres stock. Acoma is picturesquely and strongly situated on a rock mesa, 357 feet high, about 60 miles west of the Rio Grande. It was first mentioned as "Acus" by Marcos de Niza in 1539 and visited by Coronado in 1540. Acoma has the distinction of being the oldest continuously occupied town in the United States. The natives treacherously killed several Spaniards of Oñate's force late in 1598, but in the following January the Spaniards led an expedition against the mesa, stormed and captured the town, killed about half the inhabitants, and burned some of the houses. Acoma became the seat of the mission of San Estevan in 1629; the natives murdered their missionary in the revolt of 1680, and remained in their fortified retreat until 1699, when they were induced to submit to the Spanish authorities. The present large adobe church, with its remarkable cemetery filled in with earth carried from the valley below, dates from the reconquest. In prehistoric times the Acomas lived on the summit of an even loftier mesa, known as Katzima, or the "Enchanted Mesa," three miles northeastward. According to tradition (verified by an examination of the summit and the surroundings of the mesa by F. W. Hodge in 1897), the only trail was washed away in a storm, leaving some of the inhabitants to perish; the village was henceforth abandoned. Population in 1680, 1,500; in 1760, 1,052; in 1902, 566. Of the 20 original clans 6 are now extinct.

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Laguna (Span. "lagoon," from a lake formerly west of the pueblo; native name *Kawaik*).—The largest of the Queres towns, and the most recently established of all the southwestern pueblos, having been founded in 1697 by refugee Queres from other villages, particularly Acoma, as well as by Indians of other stocks. It is situated on the Santa Fé Pacific railroad, 17 miles northeast of Acoma. The town is being gradually abandoned, many of its inhabitants having moved permanently to their eight farming villages to the north and west. The Lagunas are very intelligent, honest and industrious, and are largely in demand as railroad laborers. The mission name of Laguna is San José, applied also to the rivulet on which the town is situated. The tribe has 20 clans. Population 1,143. F. W. HODGE,

Smithsonian Institution, Washington, D. C.

Queretaro, *kā-rā-tā-rō*, Mexico, a state bounded on the north by San Luis Potosi, on the east by Hidalgo and Mexico, on the south by Mexico and Michoacán, and on the west by Guanajuato. Area, 3,556 square miles. See MEXICO—THE STATES OF.

Queretaro, Mexico, capital of the State of Queretaro, distant from the City of Mexico by the National Railway 167 miles and by the Central 153 miles, and from El Paso, Texas, by the Central 1071 miles and from Laredo, Texas, by the National 580 miles; elevation 5,904 feet above sea level. Here is the famous Hercules Cotton Mill, one of the oldest and most extensive in the Republic, employing almost 2,000 operatives, and here are also several other manufacturing industries, including woolen mills. Some miles distant are the famous opal mines, which have been worked for centuries, producing enormous quantities of the precious stones, but which are now becoming gradually exhausted. The water supply is obtained from the mountains through a great stone aqueduct five miles in length. The city has a complete system of electric lighting, a well equipped street railway and many substantial business structures. The Bank of Queretaro, with a capital of \$1,000,000, a branch of the National Bank and an agency of the Bank of San Luis Potosi supply the financial needs of the community. There are numerous churches, one of the oldest and most prominent of which is the Santa Rosa. The Civil College is the most notable educational institution. In this are taught law, engineering, chemistry, etc. There are two museums, one of which is devoted to history and the other to commerce; and a library connected with the Civil College contains 9,000 volumes. Other notable buildings are the Government Palace, built of basalt, the Iturbide Theatre and a bull-ring; there are also numerous parks. The city was founded by the Aztecs about 1440; was conquered by the Spaniards in 1531 and is noted in modern history as the scene of the capture, imprisonment and execution of Emperor Maximilian in 1867 by the Mexican government. Pop. about 38,000.

Quern, a mill, especially a hand mill for grinding corn, used before the invention of water or windmills. It consisted of two circular stones, the lower of which was slightly dished,

and the upper one was pierced in the centre, and revolved on a wooden or metal pin inserted in the lower. The grain was dropped with one hand into the central opening, while with the other the upper stone was revolved by means of a stick inserted in a small opening or hole near the edge.

Quesada, kā-sā'thā, Gonzalo de, Cuban diplomatist: b. Havana, Cuba, 15 Dec. 1868. He was graduated from the College of the City of New York in 1888 and afterward studied at Columbia. He was secretary of the Cuban revolutionary party and associated with José Martí in the endeavor to effect Cuban independence. He served as special commissioner of Cuba to the United States in 1900, was Cuban commissioner to the Paris Exposition, and in 1901 became a member of the Cuban Constitutional Convention. He has published 'Patriotism'; 'History of Free Cuba.'

Quesada, Gonzalo Ximenes de. See XIMENES DE QUESADA.

Quesaltenango, kā - sāl - tā - nān'gō. See QUEZALTENANGO.

Quesnay, kā-nā, François, French economist; b. Mérey, near Versailles, 4 June 1694; d. Versailles 16 Dec. 1774. He was at first a surgeon, and in 1737 was made perpetual secretary of the surgeons' academy; but in 1744 he received a physician's certificate and became a favorite physician at the court of Louis XV. His works on professional subjects are wholly antiquated and he is best known as the chief of those economists whom Dupont de Nemours called the "physiocrats." The principal tenets of this school were that there exists a natural order, with which human government should interfere as slightly as may be, and that all wealth is derived from the soil. Extravagant praise was heaped on Quesnay, who was called the "European Confucius," while his 'Tableau Economique' (1758) was styled by Laharpe "the Koran of economists." His economical works appeared in 1768. Consult Higgs, 'The Physiocrats' (1897).

Quesnay de Beaurepaire, dé bō-rē-pār, Jules, French jurist and author, known also by the pseudonym JEAN GLOUVER: b. Saumur 2 July 1838. He studied law, became for a time a journalist, later entered definitely upon a legal career, and in 1889 was made procurator-general of the Paris court of cassation. In that capacity he appeared for the government before the Senate, constituted as a high-court of justice with charges against Boulanger (q.v.) and the latter's accomplices, Dillon and Rochefort. In 1892 he was appointed president of the chamber of the court of cassation, from which post he was compelled in January 1899 to retire, owing to the fact that his aggressive attitude in the Dreyfus revision was interpreted by his colleagues as an evidence of bias. Among his works are: 'Le Forestier' (1880); 'Histoires du Vieux Temps' (1883); 'L'Etude Chandoux' (1885); 'France, 1418-29' (1895); and 'Le Panama et la République' (1899).

Quesnel, Pasquier, pās-kē-ā kā-něl (PASCHASIUS), Roman Catholic theologian: b. Paris 14 July 1634; d. Amsterdam 2 Dec. 1719. In 1657 he entered the order of Oratorians, but subsequently through his publication of the

'Works of Leo the Great' (1675) with annotations, in which he maintained the independence of the Gallican Church, he incurred the displeasure of the Holy See, and as he refused in 1687 to subscribe to an anti-Jansenist declaration, he was obliged to take refuge in Brussels with Arnauld (q.v.) where he employed himself in completing his edition of the New Testament with moral reflections. The Jesuits, thereupon, obtained from Philip V. of Spain, a writ through which Quesnel was taken in custody as guilty of Jansenism (1703). With the aid of his brother, however, he escaped and fled to Amsterdam, where he lived to see 101 passages in his New Testament condemned by the Holy See in the bull 'Unigenitus.'

Quetelet, kēt-lā, Lambert Adolphe Jacques, Belgian statistician and astronomer: b. Ghent 22 Feb. 1796; d. Brussels 17 Feb. 1874. In 1814, he became professor of mathematics at Ghent, in 1819 was appointed to the same chair in the Brussels Athenæum and was lecturer in the Museum of Science and Literature 1828-34. Quetelet superintended the erection of the Royal Observatory and was its first director from 1828 till his death. His writings on statistics and kindred subjects are very numerous, and among them may be named: 'Sur l'Homme et le Développement de ses Facultés, ou Essai de Physique Sociale' (1835); 'Sur la Théorie de Probabilités appliquée aux Sciences Morales et Politiques' (1846); 'Sur le Système Social et les Lois qui le régissent' (1848); 'Histoire des Sciences Mathématiques et Physiques chez les Belges' (1864); and 'L'Anthropométrie' (1871). He applied the mathematical methods of averages and probabilities to the study of man both as an individual and as a member of society.

Quetta, kwēt'ta, British Baluchistan; city, on a railroad which belongs to the India railway system; and about 100 miles north of Khelat. It is a commercial and industrial centre for a large region; but it is of great strategic importance, on account of its position among high mountains and that it commands both Bolan and Khojok passes. It is strongly fortified, and has an arsenal and a garrison. It has become a flourishing place since 1876, when a British residency was established here. Pop. about 25,000.

Quet'zal. See TROGON.

Quetzalcoatl, a god of the Nahuas, primitive inhabitants of Mexico. The name Nahuas is applied to those tribes, apparently of the same origin, which successively ruled in Anahuac, or the Mexican Empire. All Nahuatl legends agree on the arrival in that region of certain bearded white strangers, garbed in black, who came to proclaim new doctrines to the Nahuas. These strangers have by some been without justification identified as Buddhist missionaries. The only definite information regarding them relates to their chief, who was called Quetzalcoatl, a name signifying, perhaps, "the serpent covered with feathers," though other meanings have been assigned. The earlier Spanish authors viewed Quetzalcoatl as St. Thomas, who had come, they thought, from India. The legendary material connected with him is extensive, varied, and confusing. He was worshipped as the incarnation of Tonacateatl, the serpent sun, and supreme deity in the Nahuatl mythology. Many temples

QUEUE ROUGE—QUICK-SAND

were built to him. Excavations everywhere unearth his image, in various guises in both stone and terra-cotta. His attributes were expressed in many bas-reliefs. American and European museums contain representations of him. A full account may be found in Bancroft (H. H.), 'Native Races of the Pacific States' (1875).

Queue Rouge, *kē roozh*, a West Indian name for a large spider much dreaded by the negroes. See *LATRODECTUS*.

Quevedo y Villegas, *kā-vā'thō ē vēl-yā'gās*, **Don Francisco de**, Spanish author: b. Madrid 26 Sept. 1580; d. Villanueva de los Infantes 8 Sept. 1645. After study at the University of Alcalá, he was banished the country for having killed a nobleman in a duel, and went to Sicily, where he entered the service of the viceroy, the Duke of Osuna, by whom he was later made minister of finance in the administration of Naples. After his return to Spain he was arrested in 1639 on suspicion of having written some satiric verses against the king and ministry, and subjected to a four years' imprisonment, the rigors of which caused his death. He is best known for his prose satires, such as 'History of the Great Sharper, Paul of Segovia' (1627), and 'Visions' (1635). The latter were rendered into English by Sir Roger L'Estrange in 1708. There is a Spanish edition of his works by Guerra y Orbe (1852). Consult the study by Mérimée (1886).

Quezaltenango, *kā-sāl-tā-nān'gō*, or **Quezaltenango**, Guatemala, city, capital of a department of the same name, the second city of the Republic in size and in importance, 80 miles west of Guatemala city, at an altitude of 7,500 feet above sea-level. The town is well-built with wide and well-paved streets; among its handsome public buildings are the cathedral, city hall, and penitentiary. It has a considerable domestic trade, and manufactures of cotton and woolen textiles. A railway about 50 miles long connects Quezaltenango with Champerico on the Pacific coast. The city was founded in 1524 by Spaniards, on the site of a native city; there are numerous interesting antiquities in the neighborhood.

Quiangan, *kē-āng-ān'*, Philippines, a former Spanish commandancia, bounded on the north by Bontoc, now a part of the province of Lepanto; area 64 square miles; pop. 30,000. See *LEPANTO*.

Quianganes, *kē-āng-ān'ās*, a tribe of the Philippines, living in the commandancia of Quiangan, province of Lepanto, Luzon. They belong to the Ifugas linguistic stock, and are a headhunting people.

Quibdo, *kēb'dō*, Colombia, town in the department of Cauca, formerly the capital of the ancient province of Choco; on the Atrato River; about 30 miles from the Pacific and 200 miles northwest of Bogota. It was of considerable commercial importance when the gold mines of the vicinity were being worked; but the majority of the mines are now abandoned owing to lack of use of modern methods of mining. The surface gold exists now only in small quantities. Pop. about 7,500.

Quiberon, *kē-brōn*, France, town, in the department of Morbihan; on the Bay of Qui-

beron, on a peninsula, about 22 miles southwest of Vannes. Nearby and on the peninsula are the noted megalithic monuments of Carnac (q.v.). Quiberon is now only a small fishing town; but it is of historical interest on account of the unsuccessful attempt of an English force to land here, in 1746, at the time of the Seven Years' war. On 20 Nov. 1759 Admiral Hawke attacked and overcame a French fleet under Admiral Conflans in Quiberon Bay, near the town. On 27 June 1795 a body of about 1,400 of French emigrant royalists landed here from an English fleet, and tried to arouse the people of La Vendée and Brittany against the Convention. They were repulsed by a force under General Hoche, some returned to their ships, and those who were taken prisoners were shot.

Quiché, *kē-chā'*, or **Kiché**, an ancient nation of western Guatemala, the people of which were civilized and of the Mayan stock. Their language was a dialect allied to that spoken by the Cakchiquel. Their extant chronicles begin with the 8th century. In their sacred book, *Popol Vuh*, an account is given of the life of their great culture hero Xbalanque. This book gives many of the national traditions, written in the Quiché dialect. The first part of the book contains mythological accounts of their history, people, events, etc.; the second part is a detailed history of the origin of the tribe and some account of the Cakchiquel. The descendants of the Quiché now inhabit a large region in the central and western part of Guatemala. Consult: Ximenez, Spanish translation of *Popol Vuh* (Vienna, 1857); Abbé Brasseur de Bourbourg, French translation of *Popol Vuh* (Paris, 1861).

Quichua, *kē-choo'ā*, **Quechua**, or **Kechua**, the tribe who founded the Indian empire of Peru. The tradition as to the origin of this aboriginal empire is that it was founded by Manco Capac, the fourth son of the "creator god," Viracocha (q.v.). Much of the legendary and traditional history has been relegated to the domain of mythology by modern research, but the mythical tale was founded on some fact in nature or history. The descendants of this tribe, a large part of the population of the Peru of to-day, are still looked upon as being a superior people. In 1781 one of the tribe proclaimed himself as the reincarnation of the great Inca Tupac Amaru, gathered about him a number of zealous followers, led a revolt against the Spanish power, which was suppressed only after two years, and upon the capture of the leader, his family, and his leading followers. See *PERU*.

Quichuan (*kē-choo'an*) **Stock**, a South American Indian group composed of numerous tribes, chief of which are the Quichua (q.v.), inhabiting Peru, parts of Ecuador, Bolivia, etc. With the Aymaras the Quichuas composed the larger portion of the population of the empire of the Incas. The Quichua language, which was formerly the state language of the Incas, is still the chief speech of Peru, of a large portion of Bolivia, of the part of Ecuador bordering upon Peru, and of the northern section of the Argentine Republic. It is one of the most beautiful and at the same time comprehensive tongues of America.

Quick-firing Guns. See *ORDNANCE*.

Quick-sand, a tract of loose sand mixed with water which will not support heavy bodies.

QUICKSILVER — QUILLER-COUCH

In appearance quick-sands do not differ from the adjacent sands. They usually occur on flat shores underlain by stiff clay or other impervious materials and especially near the mouths of large rivers. They appear to be formed by the continued collection of water within the sand bank which is prevented from running off by the underlying impervious layer. The water which infiltrates the sand may be supplied, either by a river current, directed against a concave shore, or spreading over a sea-beach; by tides which at their ebb leave behind them imprisoned bodies of water; or by sea-currents running through narrow channels and forcing the water against the adjacent shore. The grains of quick-sand have rounded surfaces, as distinguished from angular or "sharp" sand. It is, moreover, of very light weight. The infiltrated water separates and lubricates the particles, rendering them unstable and unable to support a heavy weight, such as the body of a man. They have obtained a great reputation for treachery and danger, especially because they cannot be distinguished at sight. The subject has been drawn upon considerably in literature, notably in Hugo's 'Toilers of the Sea,' in Wilkie Collins' 'Moonstone' and in the 'Bride of Lammermoor,' with probably some exaggeration of the danger. The effect of quick-sands, however, is well illustrated by the sinking in 1875 of a locomotive and train at Pueblo, Colo., which sank beyond discovery though probed for to a depth of 50 feet. To make it possible to operate in quick-sands engineers are accustomed to congeal them by forcing into them brines and liquids at low temperatures.

Quicksilver. See MERCURY OR QUICKSILVER.

Quids, in American political history, a name applied to a faction of the Republican party led by John Randolph from 1805 to 1811. They were opposed to the nomination of Madison, Jefferson's choice for the succession. They declared war on the administration party in 1806, as governing Congress by backstairs influence. They opposed the restrictive system, and nominated Monroe in 1808. Their leading ground of divergence from the administration was that it had moved away from the ground occupied by the party when in opposition, and in the direction of centralization and federal encroachment.

Quietism, a tendency in religious devotion rather than any specific system of religion or mysticism. It consists in making Christian perfection a state of uninterrupted contemplation of divine things, the soul meanwhile remaining quiet and entirely passive under the divine influence, heedless of the customary precepts of practical religion, and without thought of rewards or punishments in another world, which are the master motives of vulgar piety. The term Quietism was first used to designate the mystical teaching of Miguel de Molinos (q.v.) who died (1696) in the prison of the Holy Office at Rome to which he had been condemned for teaching in sundry of his writings that the perfect Christian life consists in passive contemplation, unaffected by hopes or desires, and that the soul thus occupied neither gains by good works or acts of piety, nor suffers through the commission even of gross sins, for these affect only the lower nature of the devotee and cannot bring any stain upon the purity of a

contemplative soul. The amiable Fénelon (q.v.) was won over to hearty acceptance of some of the less objectionable features of Quietism by the influence of his disciple Madame Guyon (q.v.), several of whose mystical writings he approved and defended when they were condemned by the Gallican church authorities, among them Bossuet, bishop of Meaux, who declared them to be a "mass of extravagances, illusions, and puerilities." Fénelon's published apology for the doctrines of Madame Guyon having been censured at Rome as containing propositions rash, scandalous, etc., he promptly bowed to the judgment of the Holy See, publicly committing his own book to the flames.

Quietists. See RELIGIOUS SECTS; QUIETISM.

Quigley, James Edward, American Roman Catholic prelate: b. Oshawa, Ontario, Canada, 15 Oct. 1854. He was graduated from Saint Joseph's College, Buffalo, N. Y., in 1872. He then began his theological studies at the Vicentian Seminary, Niagara, N. Y., now Niagara University, and continued them at the University of Innsbruck, Austria, completing his entire course at the Propaganda, Rome, where, in 1879, he obtained the degree of doctor of theology, and was ordained priest 13 April of the same year. Returning to the United States, he was appointed pastor of the Church at Attica, Wyoming County, N. Y., and in 1884 was named rector of the Cathedral, Buffalo, N. Y. In 1896 he asked to be transferred to the rectorship of Saint Bridget's Church, Buffalo, made vacant by the death of Mgr. Gleason, but his residence in that parish was short, as, on 24 Feb. 1897, he was consecrated bishop of Buffalo to succeed Bishop Ryan, deceased. Bishop Quigley was chosen arbitrator in the great labor strike in Buffalo during 1904, and on 8 Jan. 1903 was promoted to the archiepiscopal see of Chicago. The archdiocese comprises a Catholic population of approximately 1,000,000; 619 priests; 316 churches; 168 parochial schools; 7 orphan asylums; 18 hospitals, and many other charitable and educational institutions.

Quill, the hollow stem of a feather (see PLUMAGE). Many utilities have been found for those of the larger size, but their use is declining. The principal use of quills is still for making pens, for which the feathers of the swan are most highly esteemed, but goose-quills are most commonly used. Crow-quills are said to be best for fine writing and drawing. In preparing quills for making into pens, they must first be cleaned inside and outside of fatty matter, which would prevent the ink from flowing freely. This is done by burying the quill-ends of the feathers for a few seconds in fine sand at a temperature of about 140° F. The quills are then polished and dried.

Quillaia (kwil-lä'yä) **Bark**, the bark of a South American tree (*Quillaja saponaria*), belonging to the division *Spiræa* of the order *Rosaceæ*. The tree has smooth, oval leaves, and white terminal flowers, solitary or in small clusters.

Quiller-Couch, kwil'er kowch, **Arthur Thomas**, English author: b. Cornwall 21 Nov. 1863. He was educated at Oxford, where he was classical lecturer in 1886-7, and won some success with his first book, 'Dead Man's Rock' (1887). In 1887 he began a literary career in

QUILLIAM — QUINCE

London, where in 1889 he joined the staff of the 'Speaker,' the Liberal weekly newly established by Sir Wemyss Reid (q.v.). He retained until 1899 his connection with the 'Speaker,' a part of his contributions to which appear in the collections of short stories, 'Noughts and Crosses' (1891) and 'The Delectable Duchy' (1893). Among his further volumes are: 'Green Bays: Verses and Parodies' (1893); 'The Golden Pomp' (1895), an Elizabethan anthology; 'Ia' (1896); 'Adventures in Criticism' (1896); being selected reviews; 'The Ship of Stars' (1899); 'Old Fires and Profitable Ghosts' (1900); 'The Laird's Luck' (1901); 'The Westcotes' (1902); 'The White Wolf' (1902); 'The Adventures of Harry Revel' (1903); 'Hatty Wesley' (1903); and 'Shining Ferry' (1904). He also completed 'St. Ives,' left unfinished by Robert Louis Stevenson (q.v.). Much of his earlier work appeared over the pseudonym 'Q.' Much of his material he has derived from Cornwall, where he has made particular study of the Welsh poor.

Quilliam, William Henry Abdullah, English Mohammedan writer: b. Liverpool 10 April 1856. He was educated at King William College, Isle of Man, and was admitted a solicitor in 1878. He visited Morocco in 1884 and became a Mohammedan the following year. He made subsequent visits to Morocco, Turkey and Persia, and in 1895 the Ameer of Afghanistan awarded him the title of Sheik-ul-Islam of the British Isles. He has been special commissioner for Canadian oaths since 1884 and has published: 'The Faith of Islam' (1887); 'Fanatics and Fanaticism' (1888); 'Religion of the Sword' (1889); 'Polly,' a novel (1891); 'The Ways of Sin,' a novel (1894); 'Moses, Christ and Mohammed' (1897); 'Studies in Islam' (1898); 'Manx Antiquities' (1898).

Quilp, kwîlp, a malicious and hideous dwarf who figures prominently in Charles Dickens' novel, 'Old Curiosity Shop.' He torments and abuses his wife Betsey, and when about to be arrested for felony drowns himself.

Quilter, Harry, English artist and author: b. Lower Norwood, Surrey, 24 Jan. 1851. He was educated at Cambridge, studied at Bruges and in Italy, and in 1878 was called to the bar. In 1876-88 he was connected with various London newspapers, and in 1888-90 he conducted the 'Universal Review' which he founded. His first exhibition of paintings in oil was made at the Royal Institute in 1884, and in 1894 his collected works, 120 in number were exhibited at the Dudley Gallery. He is the originator of 'What's What,' first issued in 1902, and has published: 'Giotto' (1880); 'Is Marriage a Failure' (1889); 'Preferences in Art, Life, and Literature' (1892); etc.

Quimper, kăn pār', France, sometimes called QUIMPER-COARENTIN, capital city of the department of Finistère, lying at the junction of the Steir and Odet, whence the name from Breton 'Kemper,' junction or confluence. It has the fine cathedral of St. Corentin, built in 1424. The old capital of Cornouailles, it figured in the religious wars. It has sardine-fisheries, breweries, paper-factories, tanneries, and a population of about 20,000.

Quin, kwîn, James, English actor: b. Lon-

don 24 Feb. 1693; d. Bath, Somerset, 21 Jan. 1766. He was the son of an Irish barrister, and was educated in Dublin. In 1714 he went upon the Dublin stage, and a year after appeared at Drury Lane Theatre. In 1717 he went to the theatre in Lincoln's-Inn-Fields, where he remained 14 years, and acquired celebrity in characters of grave, dignified, and sententious tragedy, as in Cato, Zanga, and Coriolanus (in Thomson's tragedy of that name), and in those of strong, sarcastic, comic humor, as Falstaff and Volpone. In 1735 he returned to Drury Lane, on such terms as no actor had previously received; and he retained preeminence until the appearance of Garrick in 1741. In 1747 he was engaged at Covent Garden with Garrick; but the new actor obtained so great a share of attention that Quin retired from the regular stage in 1751. His last performance was Falstaff (1753), in which character he is supposed never to have been excelled. Garrick, once his rival and afterward his friend, wrote the epitaph for his monument in Bath Abbey.

Quinault, kē-nō, Philippe, French dramatist: b. Paris 3 June 1635; d. there 26 Nov. 1688. He studied law, but became a playwright, his first drama being produced when he was 18 and meeting with marked success. The continued success of his tragedies, comedies, and tragicomedies, of which he produced 16, made him a mark for the satire of Boileau, and he abandoned tragedy and engaged in writing librettos for the operas of Lulli. In this field he displayed great originality and though his success at the time was attributed to Lulli's music by Boileau and other critics, his verse is still read and admired while the music is forgotten. He was admitted to the French Academy in 1670 and his later years were spent in ease and comfort. Of his operatic pieces 'Armide' and 'Atys' are best known and of his dramas 'Astarte' (1663) and 'La Mère Coquette' (1665). Editions of his works were published in 1739, 1842, and 1880.

Quince, a shrub or small tree (*Cydonia vulgaris*) of the rose family; a native of central and eastern Asia, where it was cultivated more than 2,000 years ago and whence it has been introduced into all cool temperate countries of the civilized world. It is a close relative of the apple and pear, with which trees some botanists class it, but from which it is distinguished by having its flowers solitary upon the ends of twigs of the present season's growth. The popularity of the quince is limited because it is inedible in the fresh state, but it is highly prized for making preserves, jellies, etc., and as a flavoring for mixing with other fruits.

The plant is propagated mainly by stool layering, the rooted layers being grown in nursery rows usually two years after their removal from the parent bush. They are then planted from 10 to 15 or more feet apart, the distance depending upon the soil. On light soils the shrubs make rapid growth but are shorter lived and less productive than upon heavy. They should commence to bear when about three years old and reach full bearing when ten. Contrary to popular opinion the quince will do best when cultivated, but the stirring of the soil must not be deep because the feeding roots are rather close to the surface, especially if the soil be very moist. To obviate this danger, growers often

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set the plants rather deeply and for the first few years work the soil away from them so as to induce deep rooting. They always use shallow rooting cover crops. It is another popular misconception that the plants do best in undrained soil. The best orchards of western New York, where the quince is an important crop, are upon well drained land.

The tree seldom grows more than 15 feet tall. It should be trained in bush form; that is, with several stems, though some growers prefer the tree form with only one stem. The latter seems more likely to be injured by borers. Beyond the removal of interfering, dead or unnecessary limbs the pruning consists of "heading-in" the twigs, a process which reduces the number of fruits. Being fairly hardy and a rather late bloomer the quince is a very regular annual bearer, but unless the tops be kept open and the quantity of fruits reduced the specimens will be inferior. Though the fruits ripen late and when gathered are generally very hard they should be handled very carefully and not be allowed to freeze. Except as indicated the management of a quince orchard is much the same as for pear orchard.

Among the insects which feed upon the quince are several borers, scale insects, caterpillars, plant-lice, etc., which are found on other fruit trees, especially apples and pears. These may be controlled in the same way. (See APPLE; PEAR; INSECTICIDE.) The quince curculio (*Conotrachelus cratagi*), a broad-shouldered snout-beetle of American nativity, lays its eggs in the fruit in early summer. It may be controlled like its relative the plum curculio. (See PLUM.) Several so called plant diseases common to the pear and apple are sometimes reported upon the quince. They have been combated in the same way as on the other fruits.

Consult: Bailey, 'Cyclopedia of American Horticulture' (New York, 1900-2); Meech, 'Quince Culture' (New York, 1896).

Quin'cke, Georg Hermann, German physicist: b. Frankfurt-on-the-Oder 1834. He was educated at the universities of Berlin, Königsberg, and Heidelberg, and in 1859 was privat-docent at the University of Berlin. In 1872 he was appointed to a chair at the University of Würzburg, and in 1875 became professor of physics at Heidelberg. He has made important investigations of capillary phenomena, and valuable researches respecting electric influence upon different forms of matter.

Quin'cunx, an arrangement of five objects in a square, one at each corner and one in the middle. It is particularly employed in reference to the arrangement of trees. The term is frequently used in astronomy.

Quincy, kân-sê, Antoine Chrysostome Quatremère de. See QUATREMÈRE DE QUINCY, ANTOINE CHRYSOSTOME.

Quincy, kwîn'zi, Edmund, American author, son of Josiah Quincy (1772-1864 q.v.); b. Boston, Mass., 1 Feb. 1808; d. Dedham, Mass., 17 May 1877. He was graduated from Harvard in 1827, was a prominent and able contributor to the anti-slavery press and wrote: 'Wensley' (1854); 'Life of Josiah Quincy' (1867); etc.

Quincy, Josiah, sometimes called JOSHIAH QUINCY, JR., American lawyer: b. Boston, Mass.,

23 Jan. 1744; d. at sea off Gloucester, Mass., 26 April 1775. He was graduated from Harvard in 1763, studied law in the office of Oxenbridge Thacher, and acquired a large practice. After the "Boston Massacre" (q.v.), he was selected with John Adams, by Captain Preston as counsel for the defense. He wrote many political pamphlets, and contributed much to contemporary journals. In 1774 he sailed for England, where he consulted with the friends of America, but died on the return voyage. An able orator, he was among the first to assume a bold revolutionary attitude. Though he incurred at the time some odium for his defense of Parker, his course was later strongly commended.

Quincy, Josiah, American statesman and educator: b. Boston 4 Feb. 1772; d. Quincy, Mass., 1 July 1864. He was graduated from Harvard in 1790, studied law and in 1793 was admitted to practice, and gave much study to political problems. By his oration in Old South 4 July 1798, he gained so extended a reputation that in 1800 he was made Federalist candidate for representative in Congress. Though defeated then through the ridicule of Republican journals, he was elected in the autumn of 1804 after having in the spring of that year been chosen to the State senate. He remained in Congress until 1812, when he declined re-election. He was a finished orator, spoke boldly on many difficult topics of debate, and was one of the most efficient members of his party, which during his whole term of service remained hopelessly in the minority. His statesman-like grasp of affairs is most clearly shown by the constant emphasis which he placed upon the increasing political danger with which the Union was menaced by the slave power. He feared civil war, and preferred a peaceable secession—a course not then seen, as it was later, to be impossible. In the State senate he urged Massachusetts to suggest to Congress an amendment of the Constitution, by which the clause permitting slave-States to reckon three fifths of the slave population in obtaining a basis for representation was to be stricken out. Of course, such a measure, had it succeeded, would have resulted in the dismemberment of the Union. Quincy opposed the annexation of the Louisiana territory, and in his speech of 4 Jan. 1811 took the advanced Federalist position that the Constitution did not confer on Congress power to admit any new States save such as might be formed from territory belonging to the United States in 1787. He declared that, if the bill passed, the Union was thereby dissolved, and that it would be the right of all States and the duty of some "to prepare definitely for a separation." This is believed to be the earliest enunciation in Congress of the doctrine of secession. Eventually Quincy acquiesced in the purchase, upon each of the original 13 States signifying its assent. He attacked the Embargo, and opposed the War of 1812, though, unlike many Federalists, he supported the administration, and on 25 Jan. 1812 made in the House a notable speech on the navy. Upon his retirement from Congress in 1813, he was at once elected to the State Senate, where he remained until 1820, then entering the House of Representatives, of which he was speaker until his resignation in 1822 to become judge of the Boston municipal court. In this capacity he was the first to hand down the ruling,

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then much criticized but now accepted in the United States and England, that the publication of truth with good intent and for a justifiable end is not libel. From 1823 to 1828 he was second mayor of Boston; during his administration all the municipal departments were put in efficient working order. In 1829 he became president of Harvard, and this post he held until his retirement in 1845. In 1856 he was a supporter of Frémont for the Presidency. Besides several speeches, he published: 'History of Harvard University' (1840); 'History of the Boston Athenæum' (1851); 'The Municipal History of Boston' (1852); 'Memoir of John Quincy Adams' (1858), and other works. Lowell refers to him as "a figure of admirable example in a democracy as that of a model citizen." Consult: Quincy, 'Memoir' (1867); Lowell, 'A Great Public Character' in 'My Study Windows' (1867).

Quincy, Josiah, American lawyer, son of Josiah Quincy (1772-1864, q.v.): b. Boston, Mass., 17 Jan. 1802; d. Quincy, Mass., 2 Nov. 1882. He was graduated from Harvard in 1821, served as president of the Massachusetts senate in 1842, was mayor of Boston in 1845-9 and wrote 'Figures of the Past' (1882).

Quincy, Josiah, American politician, son of Josiah Phillips Quincy: b. Quincy, Mass., 1859. He was graduated from Harvard in 1880, and was admitted to the bar but never practised. He has been a leading member of the Democratic party, was chairman of that party's State Committee, and manager of the literary bureau of the National Committee in 1892. He served four years in the Massachusetts legislature, and in 1893 was appointed assistant secretary of state by President Cleveland, serving six months. In 1895 he was elected mayor of Boston and in 1897 re-elected, his progressive policy in regard to the extension of municipal functions attracting wide attention. He established the department of municipal statistics, a municipal printing-office and electrical construction department, greatly increased the number of public baths, and provided public lectures and concerts, and organized eight unpaid commissions to have charge of the city's charitable institutions, public baths and other improvements.

Quincy, Ill., the capital city of Adams County, is situated on the east bank of the Mississippi River, 264 miles south of Chicago and 160 miles north of St. Louis. It was, according to the census of 1900, the third city in the State of Illinois. It is built upon an elevated plateau 160 feet above the high-water mark of the Mississippi River. The water supply of Quincy is given from a reservoir with a capacity of 20,000,000 gallons at an elevation of 229 feet above the city, giving an average pressure of 40 pounds, the water before entering the reservoir being thoroughly filtered, making it absolutely pure. In consequence thereof the death rate has been materially decreased, making Quincy one of the healthiest cities in the world to live in. The pumping capacity is supplied by a triple expansion engine of 8,000,000 gallons daily and one compound engine of 4,000,000 gallons capacity daily, the water being filtered by 14 jewel gravity mechanical filters, therefore insuring the city over its distributing system of 45 miles of water

mains, an inexhaustible supply of water as the water is derived from an intake pipe from the channel of the Mississippi River. Quincy was settled and laid out by John Wood in the year of 1821 and to his memory there has been erected a statue in Washington Park, this being the principal part of the city. Quincy has a series of 16 nicely located parks situated in different parts of the city connected by a boulevard surrounding the city, and in all aggregating 152 acres. This in connection with the Illinois Soldiers' and Sailors' Home, which contains 140 acres, makes ample room for out-door recreation. The Illinois Soldiers' and Sailors' Home, situated upon these beautiful grounds of 140 acres, is complete in every detail and has a capacity for 2,000 veterans and the average attendance is about 1,700. Quincy's Federal building and court-house are buildings worthy of any city, so is the city-hall recently erected at a cost of \$140,000. The trade of the city is extensive and is distributed on several lines of railroad and the Mississippi River. Many of the streets are traversed by electric railways, the total extent of which is 27 miles, allowing people to go to all the principal business points and parks. The city is divided into seven wards. Of the public and charitable buildings the city contains two hospitals with the combined capacity of about 300 beds; 10 asylums and homes, and 33 churches, representing about all the denominations found in a community of the size of Quincy. Of public school houses there are 13, having been built at an aggregate cost of one half million dollars, with a corps of 114 teachers. The attendance of the public schools number 5,400 children. Besides these there are 12 parochial schools that have an attendance of 2,400 children with an attendance among the seven colleges located here that have an attendance estimated at about 1,500. The commercial interests of Quincy are represented by 1,500 firms with a capitalization of over \$15,000,000, embracing almost every kind of manufactory. Quincy is known particularly as a strong manufacturing city, there being 8 foundries with a capitalization of \$2,000,000, 7 machine shops with a capitalization of over \$1,000,000, 5 carriage manufactories with a capitalization of \$1,000,000, 5 flour mills with a capitalization of \$500,000; also the largest steam governor plant in the world, with a capitalization of \$500,000. There are also 6 breweries with a capitalization of \$1,000,000, also 4 incubator factories with a capitalization of \$1,000,000. There are also manufactories of furniture, plows, tobacco, organs, soap, files, and matches. Quincy is also well represented in the publishing line by 4 daily papers, besides numerous weeklies and monthlies, 19 in all. Pop. (1910) 36,587.

H. HATCH, M.D.

Quincy, Mass., city in Norfolk County; on Quincy Bay, and on the New York, N. H. & H. railroad. The city includes within its corporate limits several villages; its area is about 16½ square miles, nearly four square miles of which are in public parks. It is bounded on the north by Neponset River, and on the south by Fore River. It was settled in 1625 and was first known as Mount Wollaston. About four years later Thomas Morton (q.v.) obtained control of the settlement and established his "New Eng-

lish Canaan," "Merry Mount." His institution of the "May Pole" and other "Idolls," and his manner of living in general, offended the Puritans of Boston, and they thought him a dangerous man in the new country. He was arrested by Miles Standish and sent back to England. The place remained a part of Braintree until 1702 when it was incorporated as Quincy, after John Quincy. In 1888 it was chartered as a city.

The first railroad in New England was constructed here in 1826-7; it was two miles long, operated by horses, and used for carrying stone for building Bunker Hill Monument. There are many places of historic interest in and around Quincy, and some of the buildings of Revolutionary days are still in existence. Quincy came into great prominence the last quarter of the 19th century, on account of an educational movement under the leadership of Francis Wayland Parker (q.v.). Many prominent people have lived in Quincy; it was the birthplace of John Adams, John Quincy Adams, and John Hancock. The Adamsses are buried under the old "Stone Temple."

Quincy is largely a residential suburb of Boston; but the quarrying interests are still of importance. It has also a large ship-building plant, machine and tools shops. It has a city hospital, the Woodward Institute, for girls; the Adams Academy, a high school, elementary public schools, and the Thomas Crane Public Library, which contains about 25,000 volumes. The Metropolitan District System supplies Quincy with water. The government is administered under a revised charter of 1900, which provides for a mayor and council, elected annually. The school board is chosen by popular vote. The mayor appoints the heads of all departments except that of the school board. The council elects the other administrative officials. Pop. (1900) 23,899; (1910) 32,642. Consult: Adams, 'Three Episodes of American History'; Hurd, 'History of Norfolk County'; Pattee, 'A History of Old Braintree and Quincy'; Wilson, 'Where American Independence Was Born'; Adams, 'The Centennial Milestone'; Report of U. S. Commissioner of Education, Vol. I. (1902), on the Quincy educational movement; Partridge, 'Quincy Methods.'

Quinet, kē-nā, Edgar, French litterateur: b. Bourg 17 Feb. 1803; d. Versailles 27 March 1875. He was educated at the schools of Charolles and Bourg and the Lycée of Lyons. His first publication was 'Tablettes du Juif Errant' (1823). A visit to Germany introduced him to Herder's 'Philosophy of the History of Humanity,' which interested him profoundly and gave direction to his life studies. He published a translation with an introductory essay in 1827. Living at Strasburg he met Victor Cousin and Jules Michelet, the latter of whom became his closest friend. In 1829 he was chosen by the French Academy to go to the Morea as philologist attached to a commission of *savants*, and on his return in 1830 published 'De la Grèce Moderne et de ses Rapports avec L'Antiquité.' His republican sympathies were stirred by the revolution in July and his feelings gained expression in political pamphlets. He wrote a remarkable prose poem 'Ahasuerus' (1833), and later two other epics, 'Napoleon' (1836), and 'Prométhée' (1838). His purpose in these

three was to represent humanity as general, individual, and religious—Ahasuerus, the race; Napoleon, the individual, and Prometheus, the martyr. In 1838 he published a reply to Strauss' 'Life of Jesus,' the next year was appointed professor of foreign literature at Lyons and in 1841 became professor of Southern Literature in the College of France. His Lyons lectures were published under the titles, 'Génie des Religions' (1842), and 'Le Christianisme et la Révolution Française.' His lectures delivered at the College of France attacking the Jesuits so aroused public feeling that the government closed his class-room in 1846. His republican opinions became so pronounced and his expression so outspoken that after the *coup d'état* of Louis Napoleon in 1851 he was banished from France. His exile, which lasted until after the fall of the Empire in 1870, was fruitful in such works as 'Marnix de Saint-Aldegonde' (1856); 'L'Histoire de Mes Idées' (1858); 'Merlin l'Enchanteur' (1860); and the 'Révolution Française' (1865). Re-established in Paris, he was elected to the Chamber of Deputies and voted consistently against all monarchical reaction and for the secularization of laws. His last work, 'L'Esprit Nouveau' (1874), contains an expression of his social, political and intellectual creed. His complete works were published in 30 volumes (1877-82). Consult his 'Lettres d'Exil' (1884); 'Edgar Quinet depuis l'Exil,' a biography by his widow (1888-9); Heath, 'Edgar Quinet: His Early Life and Writings' (1881).

Quingua, kēng'wā, Philippines, • pueblo, province of Bulacá, Luzon; on the Quingua River, seven miles from its mouth; six miles north of the town of Bulacán. It is a road centre, and is a health resort for the surrounding provinces because of its pure water. Pop. 8,860.

Quinidine. See QUININE.

Quinine, kwīn'ēn or kwī'nīn, or Quinina, a drug ($C_{20}H_{26}N_2O_8$) most largely used in the cure of fevers. Technically known as a febrifuge (fever-cure), it is also a valuable tonic. Quinine is one of four important alkaloids obtained from the bark of the cinchona-tree (Peruvian bark; see BARK, PERUVIAN); the others being quinidine, cinchonidine, cinchonine (q.v.). The curative power of these alkaloids is accurately shown by the report, dated April 1868, of a commission appointed by the British Indian government (Madras) after the suggestion of Clements R. Markham, C.B., F.R.S. Cases of fever numbering 2,472 were treated, and the result showed failures per 1,000 as follows: Quinidine, 6; quinine, 7; cinchonidine, 10; cinchonine, 23. Quinine alkaloid is seldom used, as it is very insoluble (59° F., 1,600 parts water). The salt known as quinine sulphate ($C_{20}H_{26}N_2O_8$) $\cdot$ H $_2$ SO $_4$ + 7H $_2$ O, only is used.

The average dose of quinine sulphate for adults in the United States is 4 to 5 grains every 3 or 4 hours; in warmer and more fever-ridden countries, twice to three times this amount. The average consumption of quinine sulphate in the world at this time (1904) is 12,000,000 to 14,000,000 ounces a year, and the approximate average net cost of production is 18 cents per ounce, at which it will probably remain for a number of years, as there is very

QUINISEXT COUNCIL — QUINNAT SALMON

little likelihood of any material change in the processes of growing cinchona-bark or making the quinine.

Production and Manufacture.—Cinchona-trees grow from seeds planted in hotbeds or nurseries, and are transplanted when they have reached a height of 3 or 4 inches. They are then left till they attain a height of about 3 feet, when *Chinchona ledgeriana*, the species yielding the largest amount of quinine, but growing very poorly in the ground, is grafted on to the stalk of *Chinchona succirubra*, which yields little quinine, but grows very thriftily. This combination gives the rich yield of the former with the healthy growth of the latter. After the graft has healed, these young trees are again transplanted to cleared places in the jungle. They are fertilized and attended carefully for six years, when they have reached their most profitable age. They are then sawed down at the ground, and sawed into sections, and native women beat the sappy bark from the wood with mallets. (All parts of the cinchona-tree contain traces of quinine, but the bark is the only part containing appreciable quantities of it.) The bark is dried in the sun for a day or two, then it is dried by a fire. Finally it is roughly ground, packed in bundles of 100 kilos (225 pounds) each, and sent to the market.

To manufacture quinine, the bark is ground to a No. 70 powder (screens of 70 meshes to the inch), and mixed with lime-water sufficient to moisten the powder thoroughly. It is then mixed with crude petroleum and boiled about five hours, the quinine in the bark dissolving in the oil. The powder is then allowed to settle, and the oil is drawn off and washed with dilute sulphuric acid, agitated violently with jets of air. The quinine now leaves the oil and goes to the acid-water, in which it is more soluble than in the oil. The oil and water now separate upon standing, and the acid-water is drawn off and neutralized with soda, when the quinine and other alkaloids are precipitated. The alkaloids other than quinine are separated from it, and the quinine is redissolved in dilute acid-water to saturation while hot. Upon cooling, crystals of quinine sulphate are thrown out, filtered, and dried for the market.

History.—The virtues of the bark of what was afterward known as the cinchona-tree were discovered by the Jesuits in Peru about the year 1600. Prior to that date the Indians evidently knew that it had remedial powers, but they did not use it to any extent. In 1638 the Countess of Chinchon, whose husband, Don Luis Geronimo Fernandez de Cabrera Bobadilla y Mendoza, was viceroy of Peru, was cured of an intermittent fever by the use of this bark administered by her physician, Don Juan de Vega, on request of Don Francisco Lopez de Cañizares, corregidor of Loxa. Upon her return to Spain in 1640 the countess carried a supply of the bark with her, and through her it became known to the world. It was very fitting that 100 years later Linnæus should name the genus of trees bearing this bark for the countess—*Cinchona* (Linnæus erred in spelling; it should have been *Chinchona*).

The actual discovery and isolation of quinine is to be ascribed to the French chemists Pelletier and Caventon in 1820, although Gomez, a Portuguese, succeeded in isolating the febrile

fuge principle, which was practically quinine, in 1816. Sulphate of quinine was first made in America in 1823, and the house of Powers and Weightman, which was founded five years before this date, was undoubtedly the first to manufacture it for sale. Until about 1850 the only source of supply was found in the trees growing wild on the sides of the Andes, and as quinine had become so valuable a remedy the world over, the native forests were almost exhausted so great had become the demand for cinchona-bark. The price had reached about \$20 per ounce. The Dutch, knowing that they had in Java climate, altitude, and temperature almost identical with those in Peru, determined to secure trees or seeds and try to cultivate it there. (Cinchona requires an altitude of 3,000 to 5,000 feet, tropical temperature, without much variation, from 100 to 200 inches of rain a year, and a volcanic soil.) The British government made the same attempt in India, but with poor results, because the same conditions of soil and rain do not prevail; and after about 50 years' endeavoring to raise cinchona in India and Ceylon, there only remain a few gardens owned by the government, the product of which is consumed in the army and among the natives, to whom it is sold through the post-office at cost.

The Dutch experiment, however, proved to be very successful and remunerative, although it involved almost insurmountable obstacles, loss of years of time, and lives of earnest working scientists. The trees now thrive tenfold more than even their Peruvian ancestors, for the congenial environment found in Java, together with the shrewd methods of cultivation discovered by the Dutch, the most faithful of whom has been Van Leersum, now government director of Cinchona Undertakings, who has not even left Java for a holiday in 25 years, gave yields of as high as 10 and 12 per cent; and the writer has taken bark from trees yielding as high as 16 per cent sulphate quinine, while an average of 1½ to 2 per cent was a fair yield of the Peruvian trees.

There are now about 25,000 acres of cinchona plantations in Java, producing approximately 98 to 99 per cent of the cinchona-bark supply of the world, and in a few years there will be no supplies whatever from any other quarter.

F. L. SEELY.

Secy. Paris Medicine Co., St. Louis.

Quin'sext Council, or **Council in Trullo**, council of bishops held (692) in the hall named Trullus of the imperial palace at Constantinople. The design of this council was to supplement the purely doctrinal canons of the 5th general council (553) and of the 6th (660) with canons regulating discipline; for this reason it has been called in Latin Concilium Quinisextum (Latin, *quintus*, fifth, and *sextus*, sixth), and in Greek Synodos Penthektē (Greek, *pente*, five; *hektos*, sixth). It was attended by 211 bishops, all Oriental, and its decrees have ever been repudiated by the Western Church. Among the rules of discipline enacted by this council is one declaring married men eligible to the orders of subdeacon, deacon, and priest, but forbidding the marriage of one who is already in priest's orders.

Quin'nat Salmon, the foremost of the Pacific salmon in popular esteem and in commercial importance on account of its size, abund-

QUINNIPIAC — QUINSY

ance, and its habit of entering the rivers in the spring. It is known scientifically as *Oncorhynchus tshawytscha*, the specific name being a Latinization of that by which it was known to Russian fishermen about Bering Sea; Columbia Chinook, Sacramento and King Salmon are other names. It ascends the rivers early in spring, entering the Columbia as early as February or March, and goes to their headwaters to spawn, if not prevented,—those which succeed reaching the sources of this great watercourse about August or later. None returns alive from the spawning beds. "There is no other species of fish in the world," says Jordan, "equalling the Chinook salmon in commercial value. Of the five species of salmon on our West Coast it is approached in value only by the blueback. It reaches an enormous size; examples have been taken in Cook Inlet weighing 100 pounds, and individuals of 40 to 60 pounds weight are not infrequent. The average weight of those taken in the Columbia River has been stated to be 22 pounds, for those of the Sacramento River 16 pounds."

Quin'niapiac ("long water land"), an Indian tribe of the Algonquian linguistic stock, and probably forming a part of the Wappinger group, formerly residing on Quin'niapiac River, New Haven County, Conn. Their principal village was on, or near, the present New Haven. In 1638 they numbered about 165; in 1735 they had increased to 250; in 1768 some of them moved to Farmington, where land was bought for them, in 1774 the original settlements were reduced to 38 natives.

Quinoa, kē'nō-a, an annual herb (*Chenopodium quinoa*) of the order *Chenopodiaceæ*. It is a native of the Chilean and Peruvian Andes, and extends intermittently to Mexico. It grows about three feet tall, bears triangular leaves, very inconspicuous greenish flowers and large seeds. In general the plant resembles the common lamb's quarters or goosefoot (*C. album*), a well-known weed in American gardens. In South America and to some extent in Europe the plant is cultivated for its seeds, which are nutritious and are made into meal or fed to poultry. Its young tender foliage is also used like spinach, a related plant. Since it is a favorite food of certain insects it has not been profitably cultivated in California, where it was tried.

Quin'oline, **Chinolin**, **Leucoline**, C_9H_7N . Runge (1834) isolated an oily basic substance from coal tar to which he gave the name leucoline. Gerhardt (1842) obtained an oil by distilling quinine or cinchonine with caustic potash. He called it quinolein from its relation to quinine, but later the name was changed by Wöhler to quinoline. Hofmann (1843) showed that leucoline and quinoline were identical. It occurs also in bone-oil, and other plant alkaloids than those mentioned above give it with caustic potash. Usually made by the interaction of glycerine, sulphuric acid, aniline and nitro-benzene, and an oily liquid, colorless when pure, but becoming dark on exposure to the air, it possesses a penetrating, disagreeable odor, boiling point $239^\circ C.$, is slightly soluble in water and has a strong antiseptic action. It is a basic substance, forming soluble and easily crystallizable salts with acids. It is used to some extent as an antiseptic and in the preparation of a few dyes.

Quin'one, in chemistry, a class name which is applied to bodies that may be considered as derived from aromatic compounds by the replacement of two "ring" hydrogen atoms by two oxygen atoms. All the compounds of this class are colored and give colorless hydroquinones when reduced. Most of the quinones have the oxygen atoms in the "para" relations to each other. A very few "ortho" quinones are however known. The simplest and first known of this class is ordinary quinone or benzoquinone $C_6H_4O_2$; obtained by oxidation of quinic acid, but now usually prepared by oxidation of aniline with a mixture of dilute sulphuric acid and potassium bichromate. Its golden yellow prismatic crystals possess a peculiar pungent odor, and stain the skin yellow. Soluble in water or alcohol, they are volatile with steam and turn dark on exposure to the air. On reduction it gives hydroquinone $C_6H_4(OH)_2$, a soluble colorless crystalline body that is used extensively as a photographic developer. Quinone is a very active chemical substance, forming a large number of derivatives. Another very valuable member of this class is anthraquinone, $C_{14}H_8O_2$, a yellow crystalline body obtained by oxidation of anthracene. Related to it and obtained from it is the very valuable dye alizarine, the substance to which madder owes its value as a dye-stuff. See ALIZARINE.

Quinquagesima, kwīn-kwā-jes'ī-mā, **Sexagesima**, **Septuagesima**, the 1st, 2d and 3d Sundays before Lent. The words mean, respectively 50th, 60th and 70th, and in the Roman calendar the names of the three Sundays are *Dominica Quinquagesimæ*, *D. Sexagesimæ*, and *D. Septuagesimæ*, respectively. The use of the words is ancient, dating at least from the 7th century, but their meaning is obscure. Alcuin (9th century) suggested the numeration of 70 days from *Dominica Septuagesimæ* down to *Pascha Clausum*, the octave of Easter: but that leaves the other two names unexplained. Another explanation offered by Alcuin was that these two names are formed on the analogy of *Quadragesima* (Lent), being one and two weeks before the first Sunday in Lent: a false analogy, which assumes 7 to be equal to 10: but false as it is, it led to calling the second week of Lent *Tricesima* (thirtieth) and the third *Vicesima* (twentieth).

Quinquartic'ular Controversy. See ARMINIANISM.

Quinsy, an acute inflammation of the tonsils; acute parenchymatous tonsillitis. It is attended by fever, pain, headache, difficulty in swallowing (dysphagia), and frequently by suppuration. One attack seems to predispose to another. It is not uncommon for individuals to have attacks year after year at about the same time of the year. Disturbances of the digestive organs—diarrhoea, constipation, loss of appetite, nausea, vomiting, etc., are predisposing causes. Sudden changes of weather, exposure to damp and cold, especially after coming out of a heated room, are exciting causes.

Quinsy sets in with an uncomfortable feeling in the throat, and fever sometimes high, preceded at times by chilliness. The patient is restless and irritable, the tongue becomes covered with a thick yellowish coating, the breath is unpleasant, saliva drools from the mouth, there is

QUINT — QUINTILIUS

difficulty in opening the mouth, swallowing is attended with great effort and pain, and sometimes food returns through the nose. Pain may be severe most of the time, shooting toward the ear upon the affected side. Swelling externally behind the ears and involving the glands of the neck may be marked. A thick tone of the voice, thirst, headache, snoring, and dryness of the throat are common symptoms. Sometimes breathing is impeded, especially if both tonsils are involved. On examination of the throat one or both tonsils are seen to be bright red and sometimes covered with patches of a yellow secretion. The soft palate is red, greatly swollen, and œdematous, as is also the uvula, which not infrequently adheres to the tonsil. Quinsy may terminate either in resolution or suppuration. If resolution is to take place, in about four or five days the inflammation begins to subside, and the patient in from ten days to a fortnight may resume his ordinary employments. If suppuration is to occur, the tonsilar swelling becomes greater, and if both tonsils are inflamed they may meet, causing great discomfort. When pain and discomfort become almost unbearable, an inflamed tonsil generally breaks, and great relief and speedy convalescence follow.

Occasionally, if the disease is taken at the outset, it can be aborted by a purgative, or an emetic, and the use of one or two drops of tincture of aconite every hour. If it continues in spite of early treatment, it will probably run its course, though much can be done to palliate. Keep the patient quiet (sometimes in bed), and give hot or cold liquid foods, whichever he can swallow best. Washing out the throat with hot water every hour may be comforting, as also may inhalations of the steam of hot water, cooled by passing through a towel or a long tube. Saline laxatives are useful; so are hot compresses about the neck. Ice and cool drinks have an efficacious value. Local applications and the use of medicines and stimulants should be left to the judgment of the physician. Abscesses should be opened (not left to mature) and astringent gargles afterward used.

Quint, kwînt, Alonzo Hall, American Congregational clergyman: b. Barnstead, N. H., 22 March 1828; d. Boston, Mass., 4 Nov. 1896. He was graduated from Dartmouth College in 1846, from Andover Theological Seminary in 1852, and was ordained to the ministry in 1853. He became chaplain of the 2d Massachusetts volunteers in 1861 and served with them until 1864. After the war he was pastor of several Congregational churches successively, edited the 'Congregational Quarterly' in 1859-76, and was author of: 'Army Notes' (1864); 'Records of the 2d Massachusetts Regiment, 1861-5'; etc.

Quin'tain, an apparatus used in a military sport or exercise by men on horseback, formerly practised in England to try the agility of the country youth. The quintain was an upright post with a cross-bar on the top of it, turning round on a pivot. To one end of the bar was suspended a bag of sand, the other end was broad and flat. The horseman had to ride tilt at the flat end with his lance, and endeavor to strike it and pass on before the bag of sand could whirl round and strike him on the back.

Quin'tal, a weight of 100 or 112 pounds,

according to the scale used. See **WEIGHTS AND MEASURES**.

Quintana, Manuel José, mā'noo-ël hō-sā' kēn-tā'nā, Spanish poet: b. Madrid, Spain, 11 April 1772; d. there 11 March 1857. He was educated in the university at Salamanca, studied law, engaged in practice at Madrid, where he occupied several government offices, and soon turned his attention to literature. He was author of almost all the manifestos and proclamations issued in the war of independence and his patriotic poems soon won for him great popularity. He edited the journal 'Variedades de Ciencias, Literatura, y Artes,' founded the 'Semanario Patriótico,' and urged upon the people the necessity for resisting Napoleon. After the restoration he was imprisoned in 1814-20, and then was released by the revolution. He lived in retirement from 1823 until 1833 when he was appointed preceptor to the infant queen, Isabella. In 1835 he was elected senator and was afterward highly esteemed at court. He was one of the leading poets of his time, attaining a European reputation. As a historian he is well known by his 'Vidas de los Españoles célebres' (1807-34). His complete works are published in Rivadevieyra's 'Biblioteca de autores españoles' (Vol. XIX., 1852); and by Rojas (1897-8).

Quintet, a musical composition for five instruments or voices, accompanied or unaccompanied. (1) Quintets for stringed instruments have been written much less frequently than quartets, by reason of their complexity. Boccherini, nevertheless, wrote 125. Among famous string quintets are Beethoven's two in C and E flat, Mendelssohn's in B-flat, and Schubert's in C. There are various quintet combinations, including brass and wood-wind, as Mozart's in E-flat for oboe, clarinet, horn, bassoon, and piano. (2) Vocal quintets are also rare, but very effective. The most notable modern example occurs in Wagner's opera of 'Die Meistersinger.'

Quintilianus, kwîn-tîl-i-ā'nūs, **Marcus Fabius**, Roman rhetorician: b. Calagurris (Calahorra), Spain, probably between 35 and 40 A.D.; d. about 118. He was educated at Rome and about 69 began to practise as an advocate. Subsequently he became a teacher of rhetoric. Domitian bestowed on him the consular rank. His first important treatise, 'De Causis Corruptæ Eloquentia,' is no longer extant. His great work, 'Institutio Oratoria,' was written about 93, and embraces a statement of his theory of education together with a discussion of the principles, scope, and matter of oratory; also its manner under the general term style. The best editions of Quintilian are those of Burmann (Leyden, 1720), Capperonier (Paris, 1725), Gesner (Göttingen, 1738), Spalding and Zumpt (Leipzig, 1798-1829), and Halm (1868-9). There are also special editions of the 10th book, among which are those of Bonnell (1851), Kruger (3d ed. 1888), Peterson (1891); this book criticizes Greek and Latin literature, from the point of view of the orator and its usefulness in forming a vocabulary.

Quintilius, kwîn-tîl'i-ūs, **Aurelius Claudius**, Roman emperor, 270 A.D. He was a brother of Claudius II., and at the latter's death was ele-

QUINTUPLE ALLIANCE—QUITMAN

vated to the throne, but as the army at Sirmium had elected Aurelian emperor, Quintilius, seeing himself deserted by his followers, committed suicide. He seems to have been a man of unblemished character and to have possessed the high attributes of his brother. The length of his reign is usually placed at 17 days, but the large number of his coins extant indicates that he held the office for some months.

Quin'tuple Alliance. See **QUADRUPLE ALLIANCE**.

Quin'tus Cal'aber, or **Smyrnaeus**, Greek poet: belonging probably to the end of the 4th century A.D. His surnames are derived from the discovery of his poem in Calabria (in a convent at Otranto), and his mention of Smyrna as the place of his residence. His poem, *Παραλειπόμενα 'Ομήρου*, ('Supplement to Homer'), is a continuation of the 'Iliad,' in which he imitates, with very little originality, the poets of the epic cycles. A critical edition of this, by Tychsen, with remarks by Heyne (1807), was published by the Bipont Society. There is also an edition by Köchly (1853).

Quintus Curtius. See **CURTIVS, RUFUS QUINTUS**.

Quip'o, a cord about two feet in length, tight-spun from variously colored threads, and to which a number of smaller threads are attached in the form of a fringe: used among the ancient Peruvians and Mexicans for recording events, etc.

Quir'inal, one of the hills of Rome, not included in the ancient Septimontium, or "City of the Seven Hills," but part of the four regions of the city, and included in the Servian Wall. Next to the Palatine and Capitoline, it is the oldest and most famous part of the city. The temples of Flora, Salus, and Quirinus were on the Quirinal, and also the baths, or the great thermæ, of Diocletian and Constantine. Pope Gregory XIII. began here the erection of a summer residence which was completed by Paul V. Victor Emmanuel took possession of it in 1870, and it has since been the residence of the king of Italy. One of the principal treasures of the palace is the ceiling decoration of one room,—painted by Overbeck (q.v.). The subject is 'The Flight of Pius IX. in 1848.' Other treasures are an 'Annunciation,' by Guido Reni, and several other works of art. See **ROME**.

Quirinus, kwī-rī'nūs, Roman deity, ranking next to Jove and Mars. His origin appears indistinct but he is represented as a war god prepared for battle in times of peace. The third great flamen was assigned to his worship and his temple stood on the Quirinal Hill near the Porta Quirinalis. He was honored by the Colline Salii and a new building was erected in his honor 293 B.C., which after its destruction by fire was replaced with an imposing structure by Augustus 16 B.C. In the 1st century B.C., however, the belief that Quirinus was Romulus raised to the rank of a divinity gained credence and this opinion was favored by Cæsar and Augustus. His annual festival was celebrated on 17 January, the date of the supposed translation of Romulus to heaven.

Quirites, kwī-rī'tēz, originally the inhabitants of Cures, a Sabine town, and a name afterward applied to that portion of the Sabines

who at an early period dwelt in Rome. Quirites being applied to them in their civil capacity, while *Romani* was applied to them in their political and military capacity. On this account it was regarded by the soldiers as a great indignity to be addressed as Quirites, and Julius Cæsar on one occasion quelled a rising mutiny among his troops merely by scornfully haranguing them under the appellation of Quirites. But the contumelious sense of this name had banished before the time of the Augustan age.

Quirk, a term commonly used in architecture and carpentry: (1) A sudden turn; applied to a form of molding in which an acute recess separates the molding proper from the fillet or soffit. It is much used between moldings in Gothic architecture; in Grecian, and sometimes in Roman, architecture ovolos and ogees are usually quirked at the top. (2) A projecting fillet on the sole or side of a grooving plane, which acts as a fence or a gauge for depth or distance. (3) A piece taken out of any regular ground-plot or floor, so as to make a court, yard, etc.; thus, if the ground plan were square or oblong, and a piece were taken out of the corner, such piece is called a quirk.

Quiroga, kē-rō'ga, **Juan Facundo**, Argentine politician and soldier: b. La Rioja, Argentina, 1790; d. near Cordova, Argentina, 1835. He was educated in Spain and on his return to Argentina organized a band of rude soldiery which made him practically the ruler of north-eastern Argentina in 1820. In 1827 he appointed a governor of La Rioja, secured the election of Dorrego as president and though defeated by General Paz in 1830 became governor of Buenos Ayres in 1834. He was assassinated in the following year.

Quit and Goal, in astronomy, two terms introduced by Prof. H. A. Newton, of Yale University, to define the two points opposite each other in the heavens toward one of which the earth is at the time moving in its orbit round the sun and from the other receding.

Quit-claim, in law, a deed of release; an instrument by which some claim, right, or title, real or supposed, to an estate, is relinquished to another without any covenant or warranty, express or implied. See **DEED**.

Quitch. See **COUCH GRASS**.

Quitman, kwīt'man, **John Anthony**, American politician and soldier: b. Rhinebeck, N. Y., 1 Sept. 1799; d. Natchez, Miss., 17 July 1858. He studied law and in 1821 removed to Natchez, Miss., where he established a successful law practice. He was elected to the legislature in 1827; was chancellor of the superior court of Mississippi in 1828-31 and in 1832-4; was president of the State senate in 1835; in 1836 served as ex-officio governor of the State and in 1839 was judge of the high court of error and appeals. Interested in the cause of Texan independence he labored earnestly in its behalf, receiving at the outbreak of the Mexican war the rank of brigadier-general of volunteers. He distinguished himself in the battles at Monterey, Vera Cruz, Alvarado, and Chapultepec, was promoted major-general of volunteers and received from Congress a sword and a vote of thanks. He was appointed governor of the City of Mexico by General Scott and on his return was elected governor of Mississippi in 1850, which

QUITO—QUORUM

office he resigned in the following year when accused of complicity with the Lopez-Cuban expedition, a charge of which he was acquitted. In 1855-8 he served in Congress, where he was an ardent supporter of states rights. Consult Claiborne, 'Life and Correspondence of John A. Quitman' (1860).

Quito, *kē'tō*, capital of the Republic of Ecuador, situated only a few miles south of the equator, but at a height of more than 9,000 feet above sea-level. Climatic results of proximity to the equatorial line are modified and nearly equalized throughout the year by those of altitude; the temperature is, therefore, spring-like. It is, however, an inaccessible inland place; until 1903 (see **ECUADOR**) neither railway nor highway connected it with the seacoast. A part, at least, of the journey to Guayaquil, 165 miles away, was usually made on mule-back, along a mere bridle-path which crossed the breast of Mt. Chimborazo at a height of 14,000 feet; and the rarefaction of the atmosphere at that altitude can seldom be supported without discomfort. For the transportation of freight from the port to the interior two or three weeks have hitherto been required. Owing to its remoteness and the lack of highways, the city is visited by few strangers, and has no good hotels, no carriages, or wagons. Yet the streets are lighted by electricity, and the list of public institutions devoted to education, the Roman Catholic church, and the government, is quite impressive, including an astronomical observatory, botanical garden, school of agriculture, and other adjuncts of a "central university," with faculties of belles-lettres, science, law, and medicine. The architecture in general is that of a country subject to earthquakes—low and substantial. Features deserving special mention are the beautiful park called the Alameda, and the Sucre Theatre. The estimate of population (probably much too liberal) in semi-official publications is 80,000. See also **ECUADOR**, *History and Political Divisions*.

Quivira, *kē-vē'rā*, a "province," reputed to have been populous and rich in gold and other things, of which Francisco Vazquez Coronado, the Spanish explorer, received news from a plains Indian, known as the "Turk," while in winter quarters on the Rio Grande in New Mexico in 1540-1. Coronado started from Pecos pueblo in New Mexico, with his army, guided by the "Turk," in the spring of 1541, and after long wandering over the buffalo plains of Texas, sent the larger part of his force back to New Mexico and continued his journey due northward for 35 or 40 days, encountering the first settlement of Quivira about the present Great Bend, Kan. The province was found to consist merely of a group of villages, composed of grass lodges and inhabited by a tribe, recently identified as the Wichitas, which raised corn and hunted the buffalo. Coronado put the "Turk" to death, and after exploring the country for several months, returned by a more direct route to New Mexico. Coronado's disappointment having become forgotten, the name Quivira lingered in the minds of later Spanish explorers of the Southwest and grew to be the watchword of an unexplored Eldorado. After the abandonment of the Indian pueblo of Tabirá, in eastern New Mexico, about 1675, the idea of Quivira and its supposed wealth was transferred to the ruins of the New Mexico

village, and the name "Gran Quivira," then applied to it, has since been popularly retained. Consult Hodge, 'Coronado's March to Quivira,' in 'Brower's Memoirs of Explorations in the Basin of the Mississippi' (1899).

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Quixote, *Don*. See **DON QUIXOTE**; **CERVANTES**.

Quo Vadis, *kwō vā'dis*, a popular historical novel by the Polish novelist, Henryk Sienkiewicz, published in 1895 and familiar to American readers through the translation by Jeremiah Curtin. It deals with the history of Rome in the time of Nero. Its curious title has reference to an ancient legend, which relates that Saint Peter, fleeing from Rome and from crucifixion, meets his Lord Christ on the Appian Way. "Lord, whither goest thou?" (*Domine, quo vadis?*) cries Peter. "To Rome, to be crucified again," is the reply. The Apostle thereupon turns back to his martyrdom.

Quoin, *koin* (French, *coin*; Latin, *cuneus*, a wedge), a technical word for a wedge; (1) in artillery, the wedge used to elevate and depress a cannon or other piece of ordnance; (2) in printing, the wedges used to fix pages of type within the chase; (3) in architecture the term is applied to any external angle, but especially to the angular courses of stone projecting beyond the plane surface of the wall at the corner of a building, and specifically designated rustic quoins.

Quoits, *kwoits*, a game somewhat resembling the throwing of the discus among the ancients; only the discus was flat, while the quoit is ring-shaped. (See **DISCUS**.) The quoits are made of metal, usually iron, and are comparatively thick at the inner edge of the ring, but sharp enough at the outer edge to stick in soft clay when properly thrown. In size they vary from 8 to 9¼ inches. The game is played on a ground from 18 to 24 yards in length, at each end of which a pin called a hob is fixed in the ground to serve for a mark. The object of the game is to throw the quoits from one end of the ground to the other so as to make them stick in the ground as near the hob as possible. The best shot, called a ringer, is when the quoit surrounds the hob. The players are divided into sides, and each player has two quoits, which he delivers in succession. The winning side counts one for each quoit that it has nearer the hob than the nearest of the losing side, and if it has a ringer it counts two for it. The rules as to the size of the quoit, the distance between the hobs, and other particulars, vary with different players. In the United States quoits are generally played with cast-off horseshoes.

Quoratean (*kwō-rā-tē'an*) **Indians**, an American linguistic stock, comprising the Kworatem and Karok tribes, from the former of which the stock derives its name. The tribes occupy Lower Klamath River from the mountains a little above Happy Camp to the junction of the Trinity, and Salmon River from its mouth to its sources, in northwestern California.

Quorum, in old English law, a collective name for those justices of the peace whose presence is necessary to constitute a bench. Also such a number of officers or members of a body as is competent by law or constitution to transact business.

R

R the eighteenth letter of the English and other alphabets derived from the alphabet of the Latins. The corresponding letter of the Greek alphabet, rho, has the form ρ , which is the ϱ of the ancient Phœnician alphabet, with the loop turned to the right; in some very ancient Greek Italic inscriptions occurs the form $\mathcal{R}$ which was adopted by the Romans. $\mathcal{R}$ is classed as a liquid or semi-vowel with l , m and n . Its normal sound is doubtless either the *trill* produced by vibration of the tip of the tongue raised toward the front palate, or the *burr*, which is produced by a vibration of the lower part of the tongue and the uvula; the trill is heard in the speech of the Latin nations—Italian, French, and Spanish; the burr in that of the Germans and Scandinavians. In present English speech the r is sounded with a very faint trill or quite without a trill, save in the pronunciation of the people of certain counties of England, who produce it with a guttural vibration; in the pronunciation of this letter by the Scotch and Irish the trill is distinctly heard. When r begins a syllable and when it follows a consonant,—as in *race*, *trap*, it is distinctly a consonant; but in other situations, as in *nerve*, *hard*, *never*, it is really a vowel sound. In the faulty or affected pronunciation of certain classes r becomes equivalent to w , for example, *wevy* for very. The two liquids or semi-vowels, r and l , are sounded when the voice is modified by certain positions of the tip of the tongue relatively to the front palate; hence the two letters are freely interchanged between one language and another and within the vocabulary of one language; Spanish *azul* is English *azure*; *paralysis* becomes *palsy*; from *parabola* comes, indirectly, *palaver*. There are races or peoples who are unable to pronounce the r with either the trill or the burr or even with the slight vibration heard in English speech; in such case l takes the place of r . When in Greek a word or syllable begins with r that r is always aspirated; and the ancient Romans represented this aspiration by inserting h after the r ; this h we retain, though we recognize no difference between the *rh* of *rhabdomancy* and the simple r of *rabid*. In many English words the r found in their Anglo-Saxon originals is dropped; for example, *spræcan* becomes *speak*; on the other hand, we insert r in words which in their ancient form were without it; for example, Anglo-Saxon *brydguma* becomes *bridegroom*; and French *car-touche* becomes *cartridge*.

Ra, rä. See **RE**.

Ra-ma's Bridge. See **ADAM'S BRIDGE**.

Raab, räb, Johann Leonhard, German etcher and line-engraver: b. Schwabingen, near

Anspach, Germany, 29 March 1825; d. 1899. He was educated at Nuremberg and at the academy in Munich, and received an appointment as professor of engraving at the latter place in 1869. His work includes engravings after Raphael, Titian, Veronese, Kaulbach, Lessing, Schwind, Ramberg, and others, besides a collection of 50 etchings reproduced from the most notable works in the old Pinakothek at Munich.

Raab (Győr, dyër), Hungary, capital of a province of the same name, situated at the confluence of the Raab with a minor branch of the Danube, 70 miles southeast of Vienna, a position uniquely advantageous from both a military and commercial viewpoint. Its importance dates from early Roman occupation. A considerable trade is carried on in grain, tobacco, and horses, and in manufactures of woollen cloth and cutlery. In 1809 the combined Austrian-Hungarian forces were defeated here by the French troops under Eugene Beauharnais. Pop. about 30,000.

Rab and His Friends, a short story by Dr. John Brown, an Edinburgh physician, published in 1855. Rab's friends are his master and mistress, James Noble, the Howgate carrier, and his wife Ailie. Perhaps no truer, more convincing dog character exists in literature than that of ugly, faithful Rab. The pathos in the simple lives of himself and his friends is heightened in the tinge of Scotch dialect, as well as by the author's wise self-restraint.

Rabanus, rä-bä'nūs, or **Hrabanus, Maurus**, Carolingian prelate: b. Mayence about 776; d. there 4 Feb. 856. His education was obtained in the cloister school of Fulda, and later at Tour, where his instructor, Alcuin, surnamed him Maurus after the legendary founder of the order of St. Benedict in France. He became the head of the school at Fulda, and in 822 was elected abbot of the monastery. In 842 he resigned and retired to Petersburg, but came again into public life in 847, when he was elected archbishop of Mayence. He was one of the bitterest of the opponents of the monk Gottschalk, the originator of the predestination controversy in the 9th century. His literary activity was considerable, resulting in commentaries on the Old Testament, on the Gospels of St. Matthew and St. John, and the Pauline Epistles, devotional books, homilies, hymns, polemics, and a Latin-German Glossary to the Bible. His 'Opera Omnia' are comprised in Migne's 'Patrologiæ Cursus Completus,' reprinted from Colverino, edition of 1627. This edition contains his life by the monk Rudolph, and by Johann Trithemius. Consult studies by Spengler (1856), Köhler (1870), Richter (1882).

Rabát, rä-bät (RIBÁT'), or **Abbát,** also known as **NEW SALLÉE**, Morocco, in the prov-

RABBA—RABBIT

ince of Fez, on the Atlantic coast, 62 miles west of Mequinez. It stands on a rocky plateau, and is surrounded by massive reddish-brown fortifications. A conspicuous feature from the sea is the Hasan Tower, a minaret 180 feet high, the remnant of an ancient mosque. Rabát's manufactures are carpets, woolen, cotton, and leather goods. The Sallee pirates formerly built their ship at Rabát. Pop. 30,000.

Rabba, rä'bā, Sudan, in the kingdom of Gando (Northern Nigeria), on the left bank of the Niger; carries on an active trade in slaves, and ivory, and woolen goods. Pop. about 40,000.

Rabbi, a title of honor among the Hebrews; "my teacher," "master." John expressly states that the word was equivalent to "teacher" (Greek, *didaskalos*, rendered in the Authorized Version "master"; John i. 38). There is another form of title, *rabboni*, found in the New Testament. The form *rabban*, the Chaldaic form of the Hebrew "rab," was considered the most honorable, and was only applied to seven persons. Rabbi was also looked upon as a higher title than *rab*. It is supposed that this title first came into use at the period immediately preceding the birth of Christ. In the time of our Lord it was applied generally to all religious teachers, and hence sometimes to Christ himself. Now the term *rabbi* is applied to regularly appointed teachers of Talmudic Judaism. Since 1831 these have in France been salaried by the state. Their duties are not only to give instruction in the Talmud, but also to draw up deeds of marriage and divorce, to examine butchers, and to give their opinion as to what is legal and what is illegal in the Jewish ritual.

Rabbinical Language, that form of Hebrew in which the Jewish scholars and theologians of the Middle Ages composed their works. See JUDAISM—HEBREW LANGUAGE, JEWISH LITERATURE; etc.

Rabbinical Learning and Literature. See JUDAISM—JEWISH LITERATURE; HEBREW LANGUAGE; JEWISH PHILOSOPHICAL WRITERS; etc.

Rabbinical Legislation. See JUDAISM—THE SPIRIT OF RABBINICAL LEGISLATION.

Rabbit, a name when properly used, restricted to a single species (*Lepus cuniculus*) of the rodent family, *Leporidae*, to which the native American hares (q.v.) also belong. The rabbit is of European origin, and, although found wild in many places, is better known in the domesticated or semi-domesticated state in which it has been introduced into the United States. Although the habits of the rabbit afford the best distinction from the hares, the wild species exhibits some structural characteristics, among which are its generally smaller size, the shorter ears of uniform brown color, and the shorter limbs. The hind legs in the hares are proportionally longer than in the rabbits, and the eyes are larger and more prominent than in the latter animal. The face is also narrower and the skull lighter in the rabbit. The rabbit's fur in its native state is of a nearly uniform brown color, while under domestication the color may become pure white, pure black, piebald, gray, and other hues. The texture of the fur also changes under domestication.

Unlike the hares, which construct only simple nests or forms, the rabbit lives permanently in underground burrows, large colonies of which are often to be found in some dry sandy bank overgrown with furze or brush, or other similar locality. Such "warrens" are often specially set apart for them in order that they may breed and multiply for the market, their flesh being excellent as food, and their fur and skins of value. The burrows are irregularly disposed, and communicate freely with each other. Rabbits are extremely prolific, and begin to breed when about six months old. They may breed six or eight times a year, producing from five to seven or eight at a birth.

The parturient rabbit excavates a special burrow or tunnel for herself in which to give birth to and shelter her progeny, the nest being lined by down plucked from her own body. The young are hairless when born, and have their eyes closed. The eyes open about the tenth or twelfth day. These animals feed on tender grass and herbage, and sometimes do great damage to young trees by stripping them of their bark.

These animals grow exceedingly tame and domesticated, and may exhibit no small degree of intelligence. They are snared, taken by ferrets and nets, or may be shot. Rabbits are subject to certain diseases, such as rot, parasitic worms, and a kind of madness. The original home of the rabbit is believed to have been those parts of Europe and Africa around the western half of the Mediterranean, where it still abounds, but it is now widely spread throughout temperate western Europe, and has been conveyed by man to such distant lands as Australian colonies, Tierra del Fuego, and the Falkland Islands. In Australia and New Zealand it has multiplied so enormously as to have become a serious pest to the colonists, causing immense loss and damage by eating up the pasture intended for sheep and cattle. Various methods of extermination have been tried against them, but as yet none have had more than a moderate success. Large numbers are now killed and exported as food, frozen or otherwise preserved, and millions of skins are annually shipped to Europe and the United States. In some parts of South and Central America, and especially in Jamaica, the domestic rabbit has been introduced and established in the wild state. Darwin records several cases where quite distinct races of rabbits have resulted from their isolation on islands. An Asiatic species (*L. hispidus*) is closely related to the European rabbit, and a so-called tailless rabbit (*Romerolagus*) has recently been described from the region of Mount Popocatepetl in Mexico. It is peculiar in the possession of well-developed clavicles. All the domestic breeds of rabbits appear to have been derived from the feral species of southern Europe; and have been but little influenced by occasional crosses with hares. The Chinese, as early as the time of Confucius, appear to have bred rabbits for sacrificial purposes; and domesticated varieties are mentioned in classical Greek and Roman writers. The most noteworthy change under domestication has been the great increase in size and weight, the latter having been raised from

RABBIT-FISH — RABELAIS

3 pounds in the wild rabbit to as much as 18 pounds in the Flemish giant. This variety is bred chiefly for food, but for this purpose is less esteemed than the Belgian "hare," so-called because of its large size and hare-like color, and the unfounded belief that it originated from a cross between the hare and rabbit. The qualities which recommend the Belgian variety for market breeding are its extreme fecundity, the ease with which it may be kept in confined quarters, its rapid growth, so that it is ready for eating in about four months after birth, and the similarity of flavor of the young to the wild rabbit. A wave of enthusiasm for Belgian hare breeding passed through this country a few years ago, but has largely subsided, though many large rabbitries continue to supply the cities, particularly in the west. Of the purely fancy varieties the lop-ear is the most remarkable; the external ears in fine specimens measure 23 or even 24 inches long and 6 inches wide. The Angora, which originated in Asia Minor, has the beautiful long, silky white hair peculiar to several animals of that region, and there and in parts of Europe is bred for its hair, which is clipped and woven into underclothes, etc. Other varieties are peculiar chiefly in color. For methods of breeding, etc., consult Knight, 'The Book of Rabbit,' (London, 1889); Rayson, 'Rabbits,' (London, 1880); Carnegie, 'Practical Game Preserving'; for history, variations, habits, etc., Darwin, 'Animals and Plants under Domestication', Vol. I. (New York, 1868); Palmer, 'Jack Rabbits of the United States', (Washington, 1896); Reports of the Royal Commission of Inquiry on the Extermination of Rabbits in Australasia, especially that of 1890.

Rabbit-fish, in the Southern United States, a globe-fish (q.v.) of the genus *Lagocephalus*. In Bermuda and other islands of the Middle Atlantic, a common market-fish, caught in deep water. It is a rather large, reddish crown escolar (*Promethichthys prometheus*), and owes its name to its prominent front teeth.

Rabelais, François, frân-swâ rāb-ê-lā, French author; b. Chinon, Touraine, 1483; d. Paris 9 April 1553. He entered the Franciscan order at Fontenay-le-Comte, in Poitou, and being at first freely permitted to study, acquired Arabic, Hebrew, and Greek, and read omnivorously on almost all subjects. Eventually, however, the Franciscans came to distrust the new learning. Rabelais was deprived of his books, and in disgust fled the monastery. Shortly afterward he obtained permission of Clement VII. to enter the Benedictine order, but in no long time quitted this brotherhood also, and began to traverse the country under the habit of a secular priest. His biographers have found it difficult to follow him during this period of his life, but it seems that in his wanderings he cultivated all the sciences of the day, and especially philology, with assiduity, and that in this he exhibited powers of acquisition such as few have possessed before or since. In 1530 he was enrolled as bachelor in the faculty of medicine at Montpellier, where he lectured in 1531-2, although it was not till 1537 that he obtained the degree of doctor. In 1532 he went to Lyons, where he published 'Hippocratis et Galeni Libri Aliquot' (1532), and the first germ of his 'Gargantua' (1532), of which, according to his own account, more copies were sold in

two months than of the Bible in nine years. He was made physician to the Lyons Hospital, and was a member of the Société Angélique, a coterie of scholars that had gathered around the workshop of Gryphius, the printer. This first specimen of the power of Rabelais in the style that has rendered him famous has all the grotesque humor, amounting even to buffoonery, and the variety of marvelous adventures of his later works of the kind, but wants the delicate raillery, the sustained allegory, and profound philosophy, which most students of Rabelais find in the subsequent versions of 'Gargantua,' and still more in the last three books of 'Pantagruel.' The first part of 'Pantagruel' appeared under the anagrammatic pseudonym of Alcofribas Nesier, within a year or so after the first work, and its success was such that it passed through three editions in one year. In 1534 he accompanied, probably as physician, Cardinal Jean du Bellay, on an embassy to Rome. Not long after he is found again at Lyons, where the 'Gargantua,' as we now have it, first saw the light in 1535. In 1536 he was again at Rome, and on this occasion obtained from the Pope absolution for having neglected to enter a Benedictine house and other delinquencies. In the year following he is known to have been practising his art at Paris, but his love of wandering had not yet ceased, and his place of abode for the next eight or nine years was as unsettled as it had been during any previous part of his life. In 1546 he was probably in Paris, when the third book of his 'Pantagruel' appeared. In this the fantastical and trivial adventures that crowd the previous books give place in a great measure to regular dissertations, in which all the great moral and social questions of the day are discussed with the gaiety and irony peculiar to Rabelais, and with a freedom that roused the suspicion of the clergy, who endeavored to have it suppressed. The favor of the king secured the free publication of this book, but it was with more difficulty that a license was obtained for the fourth book from the next king (Henry II.), who had succeeded Francis in 1547. A mutilated edition of this appeared surreptitiously at Lyons in 1547. The license to publish was not obtained till 1550, and it was only in 1552 that a complete and authentic edition of the book appeared. Rabelais was installed in the cure of Meudon, which he had had bestowed on him by his former patron, Jean du Bellay, and here he seems chiefly to have resided during the remainder of his life, resigning two months before his death. He left at his death the whole of the fifth book of 'Pantagruel' in manuscript. A sixth book was intended to be added, but there is only a fragment of it indicating its subject, 'Les Noces de Panurge.' His enemies busily pointed out impieties, and he once fled to Metz to escape danger. Rabelais was one of the first to give flexibility and finish to the yet rude and harsh language of his country. Boileau calls him *La raison en masque*, and Rousseau, *Le gentil maître François*. His house was the resort of the learned; his purse always open to the needy; and his medical skill employed in the service of his parish. His work cannot now be easily understood without a glossary and commentary. It has been widely regarded, especially in France, as a treasury of wisdom, wit, and shrewd sense.

Among the best editions of the 'Gargantua'

and 'Pantagruel' may be mentioned that of Le Duchat (1711); the Variorum edition (1823-26); a splendid edition, illustrated by Gustave Doré (1858); a one-volume edition by Louis Barré (1864). Four volumes of a fine edition of his complete works, with notes and a glossary by Marty-Laveaux, appeared at Paris in 1868-81. There are English translations by Urquhart and Motteux (1653-94; new edition 1892), and W. F. Smith (1893). Consult: Besant, 'Rabelais' (1879); Besant, 'Readings in Rabelais' (1881); Stapfer, 'Rabelais, sa Personne, son Génie, son Œuvre' (1889); Gebhart, 'Rabelais, la Renaissance et la Réforme' (1895).

Rabies. See HYDROPHOBIA.

Rabshakeh, rāb-shāk'ē, an officer of the king of Assyria, mistaken in the Authorized Version of the Bible for a proper name, but in fact an official title, probably that of a military commander. He is sent with Tartan and Rab-saris, also titles of high officials, to take a threatening message from Sennacherib to King Hezekiah. He delivers it in the Hebrew tongue, and when requested to use the Aramaic dialect, the language of diplomacy, so as not to alarm the people, he insolently refuses. (2 Kings xviii.-xix.; Isaiah xxxvi.-xxxvii.)

Raccoon', the name, of Indian derivation, given to the typical members of the *Procyonidae*, a family of carnivorous mammals, resembling the bears in their plantigrade feet and other characters, but differing from them especially in the long tail, sharp snout, slender body, and moderate size. All of the five or six known genera are confined to America, though the related Asiatic genus *Ælurus* is now placed here. (See PANNA.) The members of the typical genus *Procyon* possess six incisors, two canines, eight premolars, and four molars in each jaw, and the group is well exemplified in the common raccoon (*Procyon lotor*) which derives its specific name of *lotor*, "a washer," from its habit of washing its prey before eating it, or of holding the food in the fore paws and shaking it violently backward and forward in the water so as to moisten and saturate it as thoroughly as possible. The raccoon is a heavily built animal, about three feet long, with a pointed snout, short ears and bushy tail alternately ringed with black and white. The general body color is a sooty or blackish-gray, and the fur consists of a close set of under hairs, with larger outer hairs, the latter being marked black and white. The upper part of the head and the portion across the eyes are colored dark brown. Throughout most of the United States the raccoon is abundant, and on the Pacific side reaches from Alaska to Central America. In spite of the settlement of the country and much persecution it generally holds its own, and in many sections is actually increasing in numbers. These animals, although typically carnivorous, yet seem to feed largely upon, and indeed to prefer, vegetable matters. In the natural state their food consists of all kinds of small birds and their eggs, mice, reptiles, frogs, crayfish, mussels, oysters, nuts, fruits, etc. Occasionally they catch fish or clear out a hen roost, and their frequent depredations upon fields of corn, of which they are very fond in the milk stage, has gained them the enmity of farmers. They are, as already remarked, fond of moisture and water. The German name, *Waschbär*, or "washing-bear," is

given to the raccoon for the same reason as that indicated by the specific name *lotor*. Raccoons are among the most strictly nocturnal of American mammals, and spend the day in sleep, usually in a hollow limb or tree trunk. During the winter they pass into an intermittent state of hibernation. About April four to six young are born, which remain with the parents for a year or more, forming the small parties in which these animals are usually found. The raccoons are much hunted by means of dogs, which force the animal to take refuge in a tree, whence it is dislodged by climbing. The subtlety and cunning displayed by these animals in their endeavors to escape have become quite proverbial—expressions such as "sly 'coon," "wake as a 'coon," indicating these qualities. They are, however, very easily trapped, and when taken young make very gentle and interesting pets. They use their fore paws almost as expertly as a monkey its hands, and their great curiosity prompts them to investigate everything which attracts their attention. The agouara or crab-eating raccoon (*P. cancrivorus*) is found throughout South America. It is generally larger than the common species, the tail being shorter, of a grayish-yellow tint, and marked with six black rings. The fur is blackish-gray, tinted with yellow, and of variable lights and shades over the different regions of the body. The eyes are surrounded by dark-brown patches, which run into the ears, and terminate in a patch on the top of the head. Although denominated "crab-eating," it does not appear to be specially addicted to this dietary.

Related genera are *Bassaris*, of which *B. astuta* extends from Mexico into the southwestern United States, *Nasua*, the curious arboreal coatis of Mexico and South America, and *Cercoleptes*, represented by the Central and South American kinkajou, which has a long protractile tongue. Consult: Stone and Cram, 'American Animals' (New York, 1902); and Beddard, 'Mammals' (London, 1902).

Raccoon-dog, a small wild dog-like animal (*Nyctereutes procyonides*) of eastern China and Japan, much resembling a miniature raccoon in appearance, especially about the head. It lives in burrows, gathers most of its food (fish, crabs, etc.) along the banks of rivers, and is frequently kept in captivity, especially among the Japanese, who also value its fur and eat its flesh. Its fur is long and grizzled, but handsome; its muzzle sharp, ears short, and tail short and bushy. Consult Mivart, 'Dogs, Jackals, Wolves, and Foxes' (1890).

Raccoon-oyster, a name in the Southern States for the small irregular wild oysters, growing numerously in the salt marshes, and much eaten by raccoons and other animals.

Race, Cape. See CAPE RACE.

Raceme, rā-sēm', in botany, a form of inflorescence in which the primary axis is elongated, and bears flowers placed on pedicels of nearly equal length, as in the currant. A raceme differs from a spike only in the flowers being stalked, instead of being sessile. See FLOWER.

Racer, or Blue Racer, a blacksnake (q.v.) especially the common lowland one (*Zemesis constrictor*), so called from its swiftness.

RACHEL — RACINE

Rachel, in Bible history, the second daughter of the Aramaic cattle-owner, Laban. Jacob obtained her as wife by devoting 14 years to the service of her father. At the end of the first seven years he found in his veiled bride not the Rachel promised, but Leah, her elder sister, whom he did not love, and was obliged to serve seven years more in order to gain Rachel. She was the mother of Joseph and Benjamin. Her so-called tomb stands to this day on the road between Jerusalem and Bethlehem and is held in the highest veneration by both Jews and Mohammedans.

Rachel, rā-shēl (ELISA RACHEL FÉLIX), French tragédienne: b. Munt, Canton of Aargau, Switzerland, 24 March 1821; d. Le Cannet, Provence 3 Jan. 1858. Her father was a German Jew, naturalized in France, and after much wandering about Europe established his family at Lyons, where the two oldest children, Sarah and Rachel, sang and begged in the street to help out the family support. About 1830 they removed to Paris and the two girls sang on the Boulevards until discovered by Etienne Choron, teacher in the School of Sacred Music, who undertook to teach them singing. Rachel's voice was found to be too harsh for this, and in 1834 Choron induced his friend, Pagnon Saint Aulaire, to train her for the stage. On the advice of M. Sanson she entered the Conservatoire, where, however, her harsh voice and small stature seemed at first against her. She made her debut in a play called 'La Vendéenne' at the Gymnase, 1 May 1837. The next year she joined the company of the Theatre Français and made her first appearance as Camille in Corneille's 'Les Horaces' 12 June 1838. She appeared in several parts successively and finally repeated in September her performance of Camille, was seen and applauded by the powerful critic of the 'Debats,' Jules Janin, and her position established. After appearing in other parts in the French classic drama with increasing success, she visited England in 1841 and again in 1842, repeating her triumphs there. Later while still supreme at the Theatre Français she made visits to other European cities, and in 1855 appeared in America. Here her success was only moderate, owing to her unfamiliarity with the language. A severe cold caught during her American tour ended in a consumption, from which she died at Le Cannet in the south of France. Her great reputation was made in five or six roles of the ancient classic drama of France, of these Phèdre being accounted her greatest. In the course of her career she created 13 modern roles, written for her, 'Adrienne Lecouvreur,' alone of these still holding a place on the modern stage. She appeared in several other modern roles that had been acted before her representation. Consult: *Memoirs* by Madame De B—— (1858); Janin, 'Rachel et la Tragédie' (1858); Kennard, 'Rachel' (1888).

Rachi'tis. See RICKETS.

Racine, Jean Baptiste, zhōn bā-tēst rā-sēn, French dramatist: b. La Ferté-Milon, Picardy, 21 Dec. 1639; d. Paris 21 April 1699. He studied at the College of Beauvais, and subsequently at the Port-Royal Institution, where, under the care of Lancelot and Lemaistre, he became a profound Greek scholar. In 1658 he left the

Port-Royal, and began the study of philosophy at the Collège d'Harcourt. To this period belong his first literary efforts, an ode called 'Nymphes de la Seine,' composed in honor of the king's marriage, and for which he was rewarded by Chapelain, then the dispenser of the royal bounty; and two comedies, now lost. About the same time he became intimate with La Fontaine, and this intimacy was so far from tending to make his life more regular, that those of his relations who took most interest in him, and who had destined him for the church, began to be anxious about his prospects. In 1661 he went to live with an uncle, a canon-regular and vicar-general of the cathedral at Uzès (department of Gard), whose influence it was expected would suffice for procuring him a benefice. In this last particular they were disappointed; and at the end of about two years, during which Racine had been vainly endeavoring to study theology, he returned to Paris and the world. In 1663 he was presented at court, and soon made the acquaintance of Boileau and Molière, and began to write for the stage. His first tragedy, the 'Thébaïde,' or 'Les Frères Ennemis,' was first performed by Molière's troupe at the Palais-Royal in 1664, as was also his next, 'Alexandre,' in 1665. But his devotion to the drama did not deprive him of all chance of ecclesiastical preferment, for in 1667 he received the priory of Espinay, and afterward the livings of Saint-Jacques de la Ferté and Saint-Nicolas de Chézy. The drama, however, continued for many years to be his sole serious occupation. His first two tragedies were merely tentative pieces, containing but few indications of the author's dramatic genius. His first master-piece was 'Andromaque,' which on its performance in 1667 produced a profound impression and excited well-merited admiration. It was brought out at the Hôtel de Bourgogne, Racine having in the meantime quarreled with Molière. The immediate successor of 'Andromaque' was a comedy (Racine's only extant comedy), 'Les Plaideurs,' a witty and delightful imitation of the 'Wasps' of Aristophanes. It appeared in 1668, and was at first rather coldly received, being indeed saved only by the laughter of the king. His next pieces were 'Britannicus' (1669); 'Bérénice' (1670), composed at the request of Henrietta of England, who had also invited Corneille to write a drama on the same subject; 'Bajazet' (1672); 'Mithridate' (1673); 'Iphigénie' (1674), considered by Voltaire the greatest work that the French stage has produced; 'Phèdre' (1677), the last piece that Racine produced expressly for the theatre. Little is known of the private life of Racine during this period, almost all his correspondence having been burned from a too pious respect for his memory. In 1673 he obtained a seat in the French Academy. In 1675 he was nominated by Colbert a royal councillor and treasurer of France for the general government of Moulins (Bourbonnais), but never entered on the duties of his office. His withdrawal from the theatre in 1677 was partly due to chagrin at the success of a hostile party of theatrical critics who set up for being fine wits, and applauded one Pradon, a writer now never heard of, at the expense of Racine. Soon after (1678) he was appointed, along with Boileau, historiographer to the king, whom he accompanied in his campaign to

RACINE — RACKETS

Flanders. After a silence of 12 years Racine, at the solicitation of Madame de Maintenon, added two other pieces to the list of his dramatic works — 'Esther' (1689) and 'Athalie' (1691), the latter often spoken of by French critics as the most perfect of his works. They were both intended for the pupils of Saint-Cyr, the institution founded by Madame de Maintenon. The death of Racine is said to have been hastened by grief at losing the favor of the king. As a dramatist Racine is usually considered the model of the classical or national tragic drama of the French, and in estimating his powers in this field it is necessary for the critic to take into account the stiff conventional restraints to which that drama is subjected. What Racine achieved within these limits is extraordinary. He added to the conventional drama as he received it a grace of which one would not have deemed it capable; he was greater as a poet than as a dramatist, and wrote in a style of finished perfection and distinction, developing French versification to its ultimate of rhythm and dignity. In his restraint, proportion, balance, he is rightly regarded as classic. "Perhaps it would be no exaggeration to assert," says Dowden, "that grandeur and beauty are nowhere else so united in French dramatic art as in 'Athalie.'" Besides his dramas Racine wrote several stinging epigrams, some odes and hymns, an abridgment of the history of Port-Royal, letters, and historical fragments on the campaigns of Louis XIV. Among his letters are two in reply to a work of Nicole of the Port-Royal, entitled 'Les-Visionnaires' (1666), in which the author bitterly denounces poets and still more dramatic writers. The tone of these letters is severely sarcastic, and naturally caused great offense to his old friends and masters. Only one of the letters was published at the time they were written, the other after his death. After his retirement from the theatre Racine found it easy to reconcile himself with his old friends. Among the editions of the 'Œuvres Poétiques' of Racine, one of the best is that published at Paris in three volumes (1801-5), regarded as a marvel of typography. An excellent edition of 'Œuvres Complètes' was published in 1865-73 in Hachette's collection of the 'Grand Ecrivains de la France,' preceded by an admirable essay on Racine and his time by Paul Mesnard. There is an English metrical translation by R. B. Boswell (1889-91). Consult also the study by Monceaux (1892, in the 'Collection des Classiques Populaires'); Stendhal, 'Racine et Victor Hugo' (1887); Sainte Beuve, 'Port Royal' (4th ed. 1878).

Racine, Louis, French poet and critic, son of Jean Racine (q.v.): b. Paris, France, 2 Nov. 1692; d. there 29 Jan. 1763. He attained considerable attention as a poet and critic though manifestly under a disadvantage as the son of so eminent a father. His poems 'La Grâce' (1720) and 'La Religion' (1742) were highly praised and the latter ran through 60 editions. He wrote in prose: 'Reflections upon Poetry'; 'Memoirs of the Life of Racine'; and 'Remarks on Racine's Tragedies.' His complete works were published in 1808.

Racine, Wis., city, county-seat of Racine County; on Lake Michigan at the mouth of Root River, and on the Chicago, M. & St. P., and the Chicago & N. W. R.R.'s; about 22 miles

south of Milwaukee and 65 miles north of Chicago. It has steamboat connections with all the lake ports, and electric lines extend to all the nearby towns. It is 40 feet above the surface of the lake, and 690 feet above sea-level. It was settled in 1834; in 1843 was incorporated as a village, and in 1848 was chartered as a city. Racine has a good harbor, one of the best on the lake. It is the commercial and industrial centre of a productive agricultural region about midway between Milwaukee and Kenosha. The chief manufacturing establishments are knitting mills, machine shops, flour and lumber mills, carriage factories, foundries, boot and shoe factories, tanneries, valise and trunk factories, steel spring works, hosiery mills, furniture factories, breweries, plating works, and woolen mills. The products from other manufactories are, bedding, men's clothing, paints, mangles, fanning mills, windmills, bicycles, bits, sheet iron, brass and copper goods, iron specialties, malted milk, chemicals, soap, and other articles. The manufacturing interests are increasing; it is (1904) the second city in the State in the value of its manufactures. In 1903 the capital invested in manufactories was nearly \$18,000,000; and the value of the output was over \$14,000,000. The prominent public buildings and institutions are, the government building, which cost originally \$100,000, the county court-house, the municipal buildings, Saint Luke's Hospital, Saint Mary's Hospital, Taylor Orphan Asylum, and the Dominican convent. The educational institutions are Racine College (P.E.), founded in 1852, the Racine Grammar School (P.E.), Saint Catharine's Academy (R.C.), a public high school, public and parish schools, a public library, which contains about 9,000 volumes, two libraries connected with Racine College, and the Y. M. C. A. library.

The government is administered under a revised charter of 1891, which provides for a mayor, who holds office two years, and a council. The mayor appoints, subject to the approval of the council, the members of the school board. Pop. (1910) 38,002.

Racing. See HORSE-RACING.

Rack, an instrument of torture in frequent use in the Middle Ages, and down to a comparatively recent period. It is not known to have been used in the American colonies settled under British rule, but it is among the ancient instruments of torture preserved at Montreal as relics of French rule in that country. The rack consisted of a large, open, wooden frame, within which the person to be tortured was laid on his back on the floor, with his wrists and ankles fastened by cords to two rollers at the ends of the frame. These rollers were then drawn or moved in opposite directions till the body rose to a level with the frame. Interrogations were then put, and if the prisoner refused to answer, or if his answers were not considered satisfactory, the rollers were further moved, until at last the bones of the sufferer were forced from their sockets. The rack was also used simply for purposes of punishment, apart from desire to extort a confession.

Rackets, or **Racquets**, a game played in a prepared court, open or close, with a small hard ball and a kind of bat. The bat is about two feet in length, about two thirds of which forms

the shaft or handle, the remainder being an oval frame on which is tightly stretched a net-work of cat-gut. The part of the shaft by which the bat is held is covered with leather and ribbed, to enable the player to grasp it firmly. It is from this bat and the net-work, which is its principal feature, that the game derives its name (Italian, *racchetta*, for *retichetta*, an old diminutive of *rete*, Latin and Italian, a net; French, *raquette*). The close, that is, roofed court, is now generally preferred for playing in. It is an oblong rectangular space, and when of full dimensions is 80 feet long, 40 feet broad, and has walls 40 feet high. The players stand facing one of the narrow walls, which is called the front wall. Two horizontal lines are drawn across the front wall, one two feet two inches, and the other, the out or service line, eight feet above the floor. The surface between the floor and the lower of these lines is covered with wood, which serves as a sounding-board to enable the players to know when it is struck by the ball.

The game may be played either single or double, that is, with either one or two persons on each side. It is decided by lot which side goes in first, and when there is only one player on each side the first player assumes which side of the court he pleases (usually the right), while the other stands in the opposite corner. The first player then begins to *serve*, in doing which he must have one foot in the service box of his side. Service consists in striking the ball with the bat so as to make it strike the front wall above the out line without previously striking any other part of the court, and then rebound into the opposite corner beyond the short line. In rebounding from the front wall it does not matter whether the ball strikes either of the side walls or not before it lights on the floor in the opposite corner of the court. If the ball is properly served the second player must strike it before it has made a second bound, so that it strikes the front wall above the board; but in returning the ball in this manner the player may if he likes first make it strike either of the side walls. The player to whom a ball is served does not require to wait till the ball has bounded from the floor before he returns it. He may if he likes return it before it touches the floor. Such a stroke is called a *volley*. The ball being thus returned by the second player, the first player returns the ball in the same way, and this goes on until either player fails, which may happen in three ways, either by the ball being made to hit the sounding-board, or being struck into the roof or gallery, or later than the first bound. If it is the first player who fails, his hand is out, and it is then the turn of the second player to serve. If it is the second player, then the first scores one (an ace), and the first continues to serve, but goes to the opposite side of the court. The other details of the game must be derived from the rules drawn up by the different racket clubs.

Racovian Catechism, the catechism of Rakow, Russia, where it was originally printed and published. It contained a popular exposition of Socinianism. There were two such catechisms, a smaller and a larger, both afterward published in Germany by Smalcus, the former in 1605, the latter in 1608. In 1652 John Biddle translated the larger of the two into English.

Radcliffe, răd'klif, Ann Ward, English novelist: b. London 9 July 1764; d. there 7 Feb. 1823. She was married at 23 to William Radcliffe, afterward editor and proprietor of the weekly called 'The English Chronicle.' Her first work was 'The Castles of Athlin and Dunbayne,' a Highland story (1789). It had little success, but perhaps as much as it deserved 'A Sicilian Romance' (1790) is superior to it, and 'The Romance of the Forest' (1791), a still further advance, was dramatized and translated into French and Italian. Her master-piece is considered to be 'The Mysteries of Udolpho' (1794), which was long very popular. The last of her novels published during her life was 'The Italian' (1797), dramatized as 'The Italian Monk,' and translated into French by Morellet. A posthumous romance, 'Gaston de Blondeville,' was edited by T. N. Talfourd in 1826, together with some poems. Another work of hers was 'A Journey through Holland and Germany' (1795). Mrs. Radcliffe's novels were at one time very popular. She had considerable power in the description of scenery, and well understood how to excite and maintain the curiosity of her readers. She was perfect mistress of the mysterious in romance and the first English writer of note to introduce descriptions of scenery into fiction. Consult: Beers, 'English Romanticism' (1898).

Radcliffe, John, English physician: b. Wakefield, 1650; d. London 1 Nov. 1714. He was educated at Oxford and there began the practice of medicine, but removing to London in 1684 soon established a large practice which he maintained, it is said, more by his witty conversation than his medical skill. In 1686 he became physician to the Princess Anne of Denmark, and frequently attended William III., after his succession. His bluntness of speech lost to him the favor of Princess Anne and later of King William, though he continued to number many of the nobility among his patients and prescribed for Pope and Swift. His learning was often depreciated; but he seems to have been an acute observer of symptoms and his immense practice gave him a wide field for observation. By his will property was left in trust for the foundation of two medical fellowships, and for the purchase of perpetual advowsons for members of University College. He also left money for the erection of various public buildings, among which was £40,000 for the public library in Oxford, since called the Radcliffe Library. From estates left in trust to the executors to administer for charitable purposes according to their judgment were built the Radcliffe Infirmary, the Observatory at Oxford, and enlargements to St. Bartholomew's Hospital. Later money was granted toward the buildings of the College of Physicians in London, the Oxford Lunatic Asylum and St. John's Church, Wakefield.

Radcliffe, England, in the county of Lancashire, seven miles northwest of Manchester, on the River Irwell. The ancient parish church of St. Bartholomew dates from the time of Henry IV. There are cotton and calico works, bleach-fields, and extensive collieries in the vicinity.

Radcliffe College, a college for the education of women, affiliated with Harvard University, Cambridge, Mass. Its forerunner was the

RADECKE — RADIATION

Society for the Collegiate Instruction of Women, organized in 1879 to provide systematic instruction for women by professors and instructors in Harvard. This Society was incorporated three years after its organization, and its educational work proved so successful that in 1894 it was formally affiliated with the University. At that time the name of the Society was changed to Radcliffe College, power to grant degrees was conferred, and the president and fellows of Harvard University were constituted the board of visitors of Radcliffe, which should have supervision over the administration of the affairs of the college, the granting of degrees, the appointment of instructors, etc. All diplomas given by Radcliffe are countersigned by the president of Harvard and bear the University seal. Most of the courses of study are identical with the Harvard courses, and graduate students are admitted to some of the graduate courses of the University. The courses are divided into three groups in the different branches of study: (1) courses primarily for undergraduates; (2) courses for graduates and undergraduates; (3) courses primarily for graduates. Courses in Semitic languages and history, history and theory of education, pedagogy, and the history and theory of art and music, are included in the curriculum. The degrees of A.B. and A.M. are conferred. There are two fellowships, one for the promotion of the study of Greek history, literature, art and archæology of the American School at Athens, and one for the promotion of the study of social problems at a settlement house in Boston; there are also eleven scholarships. The college has laboratories of physics, chemistry, zoology, and botany,—the library numbered 26,000 volumes in 1910; the University library and museums are also opened to students of Radcliffe; in 1904 a new hall fully equipped with auditorium, club rooms, etc., was built. The students in 1910 numbered 485 and the faculty 104. Le Baron Russell Briggs of Harvard University was appointed president in 1903.

Radecke, rä'dé-ké, Robert, German composer: b. Dittmannsdorf, Silesia, 31 Oct. 1830. He was educated at the Conservatory of Leipsic and in 1853 became musical director of the Stadt Theatre of Leipsic. He afterward served for a year in the army and then settled in Berlin where he engaged as second violin in Laub's quartet and in 1858-63 conducted choral and orchestral concerts with much success. In 1863 he was appointed musical director of the Royal Opera and in 1871 was made royal Kapellmeister for life. He was the successor of Haupt as director of the Royal Institute for Church Music in 1891. Radecke excels as a performer on pianoforte, organ, and violin, but his greatest talent is shown in his compositions, which include about 100 songs, the operetta 'Die Mönkgüter'; overtures, 'König Johann'; 'Am Strande'; etc.

Radegun'da, Saint, Frankish queen: b. Thuringia, Germany, 510; d. Tours, France, 13 Aug. 587. She was the daughter of the heathen Berthar, king of the Thuringians, and was carried off prisoner when a child after the victory of Clothaire, king of the Franks, over her father. She was eventually converted to Christianity and married to Clothaire (538). In 553 she took the veil, founded the monastery of

Sainte Croix at Tours, and made her dwelling there. Her life was written by her contemporary and friend, the famous poet, scholar and bishop, Venantius Fortunatus (q.v.). Consult: Bussierre, 'Histoire de Sainte Radegonde' (1864).

Radetzky, rä-dët'ské, Johann Joseph Wenzel Anton Fritz Karl, COUNT, Austrian military officer: b. Trebnitz, Bohemia, 2 Jan. 1766; d. Milan, Italy, 5 Jan. 1858. He joined the Austrian army in 1784, served in the campaigns against the Turks in 1788-9, in 1809 became lieutenant field-marshal and served with ability at Aspern and Wagram. After the peace of Schönbrunn he was appointed a member of the state council of war. In the war with France he fought at Kulm and Leipsic in 1815, and in 1831 was made commander of the Austrian troops in Italy. He was created field-marshal in 1836 and in 1848-9 he crushed the revolution in Venice and Milan. He preserved Lombardy to Austria, routed the army of the Piedmontese at Custoza and Novara in 1849, concluded a treaty which assured Austrian supremacy in Italy for the time, and governed the Austrian possessions there until 1858 when he resigned. Consult: Troubetskoi, 'Campagnes du Comte Radetsky dans le Nord de l'Italie en 1848 et 1849' (1860); Kunz, 'Die Feldzüge des Feldmarschalls Radetsky in Oberitalien' (1890).

Rad'ford, William, American naval officer: b. Fincastle, Va., 1 March 1808; d. Washington, D. C., 8 Jan. 1890. He entered the navy in 1825, served in the war with Mexico, and performed gallant service at Mazatlan. When the Civil War broke out he was assigned to the Cumberland; was promoted captain in July 1862, and commodore in April 1863. During the assaults on Fort Fisher, in 1864-5, he commanded the New Ironsides and the ironclad portion of Porter's fleet. He was promoted to rear-admiral in July 1866, was in charge of the European squadron in 1869 and was afterward on duty in Washington until he was retired in March 1870.

Radhanpur, rä-d-han-poor', India, (1) chief town of a state in the Bombay presidency surrounded by a wall which encloses a fortified castle and the residence of the native prince. A fine sort of saltpeter is manufactured and there is some trade in cotton, wheat and grain. Pop. 14,722. (2) The state of Radhanpur in the northwest of Gujerat, covers an area of 1,150 square miles. Pop. 98,129.

Ra'dian. See MECHANICS.

Radiant Star, Order of the. See ORDERS (ROYAL) AND DECORATIONS.

Radia'ta, one of the great divisions of the animal kingdom in the classification of Cuvier, characterized by having the parts of the body arranged around a vertical axis like the spokes around the hub of a wheel. Later, it was shown by Leuckart that the group was unnatural, and it has been discarded for many years. Its chief numbers are now included in the *Celenterata* and *Echinodermata* (q.v.). As limited by Cuvier it also embraced some of the *Protozoa*, the *Polysoa*, some parasitic worms, and a few other forms.

Radiation. By radiation is meant the propagation of energy in straight lines from a radiant point. This radiation is in the form of vibrations connected with an ether which fills

RADIATION

all space, both molecular and stellar. Such energy is best known as radiant heat, and when the vibrations are of sufficient rapidity to excite the nerves of vision, it is called light. Such a conception presupposes the origin of the radiations to be the oscillations of the ultimate particles of matter. The mode of propagation is a wave motion, to and fro, across the line of radiation. In sharp distinction from this was the material theory of heat, held by some physicists

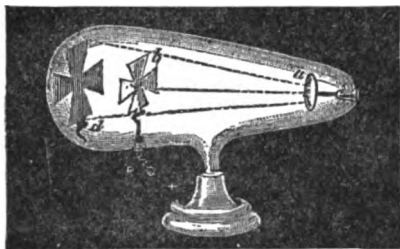


FIG. 1.—The radiant energy from *a* traveling in straight lines is intercepted by the aluminum cross *b*, which casts its shadow at *d*.

previous to the investigations of Balfour Stewart, by which "caloric" or heat was regarded as "imponderable matter" stored up, or driven from bodies by chemical or mechanical means. Strange to say, the latest discoveries in radiation, point back to this long discarded theory.

Radiations of Heat and Light.—Physical science, at the opening of the 20th century, had established the mutual relationships of heat and light. (1) Both had been found to be propagated in straight lines, with a speed approximately of 186,000 miles per second. (2) The laws of reflection and refraction were the same in each. (3) The intensity of radiant heat, and that of light, varied inversely as the square of the distance. (4) Synchronism of vibration, interference of wave motion, and polarization were the same in each. (5) They were alike subject to selective absorption, and absorption was equivalent to radiation.

By means of the *spectrum*, the wave-lengths and frequency of vibration corresponding to different degrees of radiant heat, light, and actinic power had been ascertained. For instance, we know that, beginning at the lowest radiant heat measurable, we have in the neighborhood of 12,500,000,000 vibrations per second, and 944 millionths of an inch as the length of the wave. As the vibrations become more rapid and the length of the wave shorter, radiant heat becomes luminous and is known as light.

Vibrations and Wave-lengths.—With a vibration period of about 344,000,000,000 per second, and a wave-length of 32 millionths of an inch, particles of matter assume a dull red color. From this point on they pass successively through the colors of the spectrum—namely, red, orange, yellow, green, blue, indigo, and violet, until the eye, by reason of its physical limitations, ceases to take cognizance of them. At about 700,000,000,000 vibrations per second and a wave-length of 16 millionths of an inch, they are known as actinic or ultra-violet rays. The photographic plate responds to these rays up to 1,485,000,000,000 vibrations per second, with a wave-length of 7.95 millionths of an inch, and they will produce fluorescence up to a period of

1,621,000,000,000 vibrations, with a wave-length of 7.28 millionths of an inch. Scientific investigation is now largely confined to these *higher radiations*. As a starting point, we begin with investigations of Professor William Crookes, who discovered in 1879 that the highly attenuated matter in a vacuum tube, through which the discharge of an induction coil is passing, becomes luminous as the exhaustion of the tube increases. While Crookes' theory of a fourth state of matter, known as "radiant matter," has not been wholly approved or disapproved, it remains as the basis of modern discoveries in radiation. In all highly exhausted vacuum tubes, a small dark space surrounds the negative electrode during the electric discharge.

Radiations in Vacuum Tubes.—Crookes found that the dark space increases in length as exhaustion proceeds.

The explanation, according to Professor Crookes, is that the molecules of attenuated matter travel over comparatively long spaces before coming into contact with other molecules, which by their collision produce light.

The radiant energy within the tube travels in straight lines. Shadows are cast by intercepting objects, as in the case of light. (See Fig. 1.) Mechanical motion can be produced by directing the radiant energy against a light wheel. (See Fig. 2.) Crookes' radiometer, a familiar piece of apparatus seen in opticians' windows, operates on this principle and that of re-action. Significant discoveries in this connection followed: first, that the stream of radiant energy could be deflected by a magnet; second, that two streams of radiant energy re-

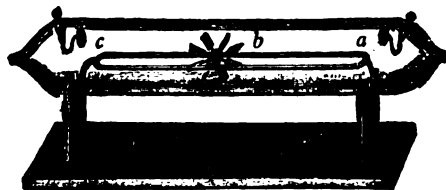


FIG. 2.—The stream of radiant matter from *a* strikes the upper vanes of the little paddle-wheel *b*, and causes it to roll along the rails. If the tube is inclined, the force is sufficient to drive the wheel up hill.

pelled each other, after the manner of matter similarly electrified; third, that the stream of radiant energy, when focused upon a metal, such as irido-platinum, heated it white hot. Glass also cracked and softened under its impact.

In 1894, Lenard, acting on a hint from Hertz, constructed a window of thin aluminum connected with the positive pole in Crookes' vacuum tube, and found that a faint bluish glow extended through the window into the air outside, and vanished at about two inches from the window. In this glow, uranium glass, calc spar, and a few other substances became phosphorescent. The radiations passed through screens of gold leaf, silver or aluminum easily. Electrically charged bodies were found to be discharged in the glow outside of the window and even beyond its visible limits.

Roentgen or "X-rays."—In 1895 Prof. Roentgen, of the University of Würzburg, discovered that a Crookes' tube covered with black card-

RADIATION OF HEAT—RADICAL

board emitted rays which penetrated the glass and cardboard. He immediately investigated their origin with a vacuum tube similar to Lenard's, but with a glass instead of an aluminum window, and found the source of these unknown rays in the window itself, where the impact of the radiation inside of the tube took place. He found that these unknown or "X-rays" were not the same as the radiation inside of the tube. The latter were deflected by a magnet, the "X-rays" were not.

The "X-rays" penetrated glass, tin, aluminum, or, generally speaking, metals of low atomic weight, while the radiant energy inside the tube possessed no such penetrating power. The "X-rays," however, will produce fluorescence—chemical action, and discharge electrified bodies—the same as ultra-violet rays. *They are not refracted, nor reflected, nor subject to diffraction, like light, and Prof. Alfred M. Mayer, of this country, has shown that they are incapable of polarization.* These latter facts regarding diffraction and polarization, as well as the non-interference of "X-rays," go to prove that they cannot be propagated according to the laws of wave motion, hence the theory of radiant energy assumed at the beginning of this article finds here an exception. In the case of the radiant energy within the vacuum tube, it seems evident that the phenomena are the result of streams of electrified particles of residual matter, shot off from the cathode in straight lines perpendicular to its surface. These flying particles falling upon anything in their path will give rise to "X-rays." The most important applications of the "X-rays" have been in the fields of anatomy, surgery, and diagnosis, where, owing to their ability to penetrate animal tissues, they have been extensively used to locate foreign bodies, and for the examination of dislocated bones and abnormal growths.

In 1896 M. Henri Becquerel discovered the presence of invisible radiations proceeding from the salts of uranium, and later from uranium itself—which radiations penetrated aluminum and produced shadow pictures somewhat after the manner of "X-rays." These radiations were proved to have their source within the substance of the uranium itself. This brings the subject of radiation down to the remarkable properties of radium, discovered by M. and Mme. Curie, of Paris, in 1898. See RADIUM.

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Radiation of Heat. See HEAT.

Rad'ical, the name adopted by a large section of the Liberal party in Britain, which desires to have all abuses in the government completely rooted out, and a larger portion of the democratic spirit infused into the constitution. The immediate aim of Radicals at different times has necessarily varied considerably; and though the party is now identified almost exclusively with political reform, the Radicals of the past achieved their greatest success in compelling attention to important economic changes tending to improve the condition of the laboring population. The term is applied in general usage to persons of extreme views in connection with so-called political and social reforms.

Radical, or **Radicle**, in chemistry (and particularly in organic chemistry), a name given

to certain molecular groups whose constituent atoms possess such relations and affinities that the groups themselves persist and maintain their integrity, even when the compounds in which they occur undergo profound chemical change. The following example will illustrate the nature of a radical more clearly: Ordinary alcohol (ethyl alcohol), when free from water, has the chemical formula C_2H_5O . If this be saturated with hydrochloric acid gas in the presence of chloride of zinc, a compound having the formula C_2H_5Cl is formed; and by treating the alcohol with iodine under proper conditions, an analogous compound having the formula C_2H_5I is obtained. When this last substance is heated with water and metallic zinc, we obtain the hydrocarbon gas ethane, C_2H_6 . These reactions, and others of a similar nature, suggest that the molecular group C_2H_5 persists through all of these changes; and this hypothesis is found to be justified in every way. The group C_2H_5 is therefore a "radical," and to it the name "ethyl" has been given. The gas ethane, C_2H_6 , is the hydride of ethyl, according to this view, and its formula may be written $C_2H_5.H$. Similarly, C_2H_5Cl and C_2H_5I are known, respectively, as ethyl chloride and ethyl iodide. Ethyl alcohol, in the same way, is regarded as the hydrate of the radical ethyl, and its formula is written $C_2H_5.OH$. Ethyl is thus seen to be a monovalent radical with a high degree of stability, behaving, in its chemical relations, very much like the alkali metals, potassium and sodium. Many compounds are known in which two or more molecules of ethyl occur, with their combined valencies satisfying a single divalent atom or radical. Ordinary ether, for example, is the oxid of ethyl, its formula being $(C_2H_5)_2O$. The analogy of this substance with the oxid of potassium, K_2O , is complete.

If the persistence of a radical were absolute, so that we could never destroy the radical by any chemical or physical means, we obviously could not distinguish it from an element; and it is quite possible that some of the bodies that we now recognize as elements are merely radicals of extraordinary persistence, but which we may some day succeed in breaking up into their constituents. This is pure speculation, however, and until we know more about the ultimate constitution of matter, we are to regard a "radical" merely as a convenient conception, which enables us to simplify chemical formulæ, and to form a clear general view of the analogies and chemical relations that subsist among various chemical compounds. Radicals may be classed as "acid" or "basic," according as they have an acid or a basic character. Thus the radical SO_4 , which occurs in sulphuric acid and in the sulphates, and which is called "sulphion," is an acid radical, while ethyl, C_2H_5 , is basic.

Among the simpler inorganic radicals that are of frequent occurrence, the following are monovalent: Hydroxyl (OH), the "nitro" group (NO_2), the "nitroso" group (NO), the "amido" group (NH_2), and cyanogen (CN). The following are divalent: Sulphion (SO_4), sulphuryl (SO_2), the "imido" group (NH), and the "thionyl" group (SO). In organic chemistry many radicals are recognized. The commoner basic radicals of the fatty series may be re-

RADIGUET — RADIOACTIVITY

garded as derived from the saturated hydrocarbons (or paraffins) by the removal of one or more atoms of hydrogen. Thus we have the following series, which are derived in the manner described, the radicals in each column being obtained from the paraffin at the head of that column by the removal of hydrogen atoms:

CH_3	C_2H_5	C_3H_7	C_4H_9	C_5H_{11}
Methane	Ethane	Propane	Butane	Pentane
CH_2	C_2H_4	C_3H_6	C_4H_8	C_5H_{10}
Methyl	Ethyl	Propyl	Butyl	Pentyl
CH	C_2H_3	C_3H_5	C_4H_7	C_5H_9
Methylene	Ethylene	Propylene	Butylene	Pentylene
CH	C_2H_2	C_3H_4	C_4H_6	C_5H_8
Methenyl	Ethenyl	Propenyl	Butenyl	Pentenyl
C	C_2H	C_3H_2	C_4H_3	C_5H_4
(Carbon)	Ethine	Propine	Butine	Pentine

The names here assigned to the radicals are due to Hofmann, and the system in accordance with which they are formed will be sufficiently evident, without further explanation. Hofmann's names are now commonly adopted, but some of the foregoing radicals are still known by other names also. Thus Hofmann's "ethenyl" is often called "vinyl"; and, similarly, his "propenyl," "butenyl," "ethine," "propine," and "butine" are respectively known as "glyceryl," "crotyl," "acetylene," "allylene," and "crotonylene."

The radicals tabulated above, and which are of constant occurrence in organic chemistry, contain only hydrogen and oxygen. Many organic radicals are known, however, which contain other elements also. The first oxygen-bearing group to be recognized as a radical was "benzoyl," $\text{C}_6\text{H}_5\text{CO}$, which occurs in benzoic acid, and in many other compounds that are related to the oil of bitter almonds. This radical was recognized by Liebig and Wöhler, in 1832. Many such radicals are now recognized, especially in the organic acids and their derivatives. As an example, "acetyl" may be cited. This has the composition $\text{C}_2\text{H}_3\text{O}$, and acetic acid, $\text{C}_2\text{H}_4\text{O.OH}$, is its hydrate.

Many of the radicals are not capable of independent existence, and hence cannot be isolated. Others may be obtained in the free state, or in the form of a compound in which two similar radical groups are united to each other. When methyl iodide is heated with metallic zinc, the iodine is taken up by the zinc, and the methyl radical, CH_3 , is liberated. It is not obtained in the form of methyl, however, for at the moment of its liberation two of the radicals combine to form a molecule of ethane, C_2H_6 . Ethane, therefore, may be regarded as "di-methyl," having the formula $\text{CH}_3 - \text{CH}_3$, or as "ethyl hydride," having the formula $\text{C}_2\text{H}_5\text{H}$. It is convenient to regard it from one of these points of view for some purposes, and from the other for other purposes. A radical of the series tabulated above can exist in the free state, save for a slight change in its internal linkage, provided its valency is an even number, and the free bonds belong to adjacent carbon atoms. Ethylene, for example, has the formula C_2H_4 . When it exists as a radical, in combination with other atoms, it is divalent, and has the structure $-\text{CH}_2$;

$-\text{CH}_2$; the two carbon atoms being connected by one internal bond, while each carbon atom also has one bond which is satisfied by the ex-

ternal atoms with which the radical is combined. When the ethylene exists as a free hydrocarbon, the two free bonds shown in the foregoing rational formula satisfy each other, and the constitution of free ethylene therefore



The idea of a compound radical is due to Lavoisier; and the conception, although its validity was earnestly disputed for some years, has been of great importance in the development of chemistry. The definition of a radical, as given by Liebig in 1838 in his discussion of cyanogen, holds good at the present day. He said: "We call cyanogen a radical because (1) it is the invariable constituent in a series of compounds; (2) because it can be replaced in these compounds by other simple bodies; (3) because in its compounds with a simple body the latter can be replaced by equivalents of other simple bodies." At least two of these three characteristics must be fulfilled by a group of atoms, before that group can be regarded as a "radical."

Consult Hjelt, 'General Organic Chemistry'; Meyer, 'Modern Theories of Chemistry.'

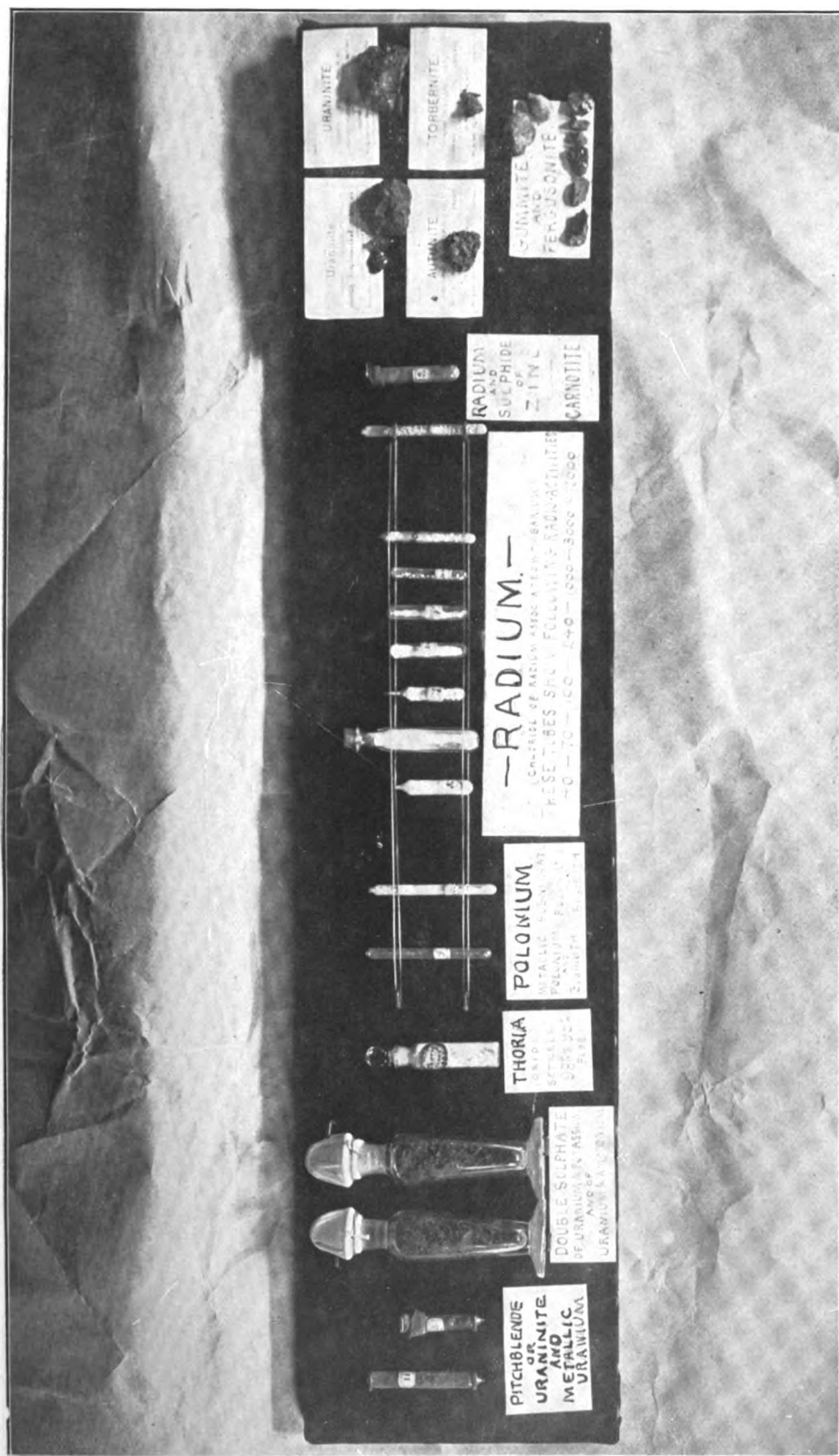
A. D. RISTEN, PH.D.,

Editorial Staff, 'Encyclopedia Americana.'

Radiguet, Maximilien René, French explorer: b. Landerneau, Finisterre, 17 Feb. 1816; d. 1892. He was educated in the School of Fine Arts at Paris, and in 1838 became secretary to Admiral Charles Baudin and Count de Las Casas, on a mission that had been sent to Haiti to negotiate with the government of that country for the payment of an indemnity to the descendants of the French citizens that had been murdered during the troubles of 1798-1803. His influence was of great value in bringing the negotiations to a speedy conclusion, several times preventing the impatient admiral from bombarding Cape Haytien. He was afterward secretary to Admiral Du Petit-Thouars, 1841-5, and traveled through South America and the Marquesas Islands, and afterward devoted himself to literary labors. Among other works he has published 'Souvenirs de l'Amérique Espagnole: Chile, Pérou, Brésil' (1856; revised ed. 1874).

Radioactivity. Although only nine years have elapsed since Becquerel (1896) discovered that uranium possessed the property of spontaneously and continuously emitting penetrating rays, capable of passing through bodies opaque to ordinary light, our knowledge of the subject of radioactivity has increased with great rapidity and a very large mass of experimental facts has now been accumulated. Only a very brief account of the remarkable properties possessed by the radioactive bodies is possible in this short article.

Shortly after the discovery of this property in uranium, Mme. Curie and Schmidt independently found that the heavy element thorium, which is used in the manufacture of Welsbach mantles, was also radioactive and to about the same degree as uranium. The latter substance is commercially obtained from the mineral pitchblende and in an examination of the radioactive properties of this mineral, Mme. Curie was led to the conclusion that other and more



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radioactive substances must be present in it. By an admirable piece of chemical research, Mme. and P. Curie succeeded in separating from it two new very active substances which were called radium and polonium. The substance radium was well named as, in the pure state, it gives out radiations about two million times as intense as uranium. Polonium has not yet been chemically isolated. It differs from radium in losing its activity with the time. Several years after separation, the activity has diminished gradually to a small fraction of its original value.

Another substance called radio-tellurium was separated from pitchblende by Marckwald. It has radioactive properties similar to polonium, and probably contains the same radioactive constituent. In addition to these bodies, Debierne and Giesel independently discovered another very active substance called actinium, while Hofmann found that lead separated from pitchblende was very active and called the radioactive substance present in it "radio-lead." With the exception of radium, none of these bodies have been chemically isolated. Actinium (or emanium, as it is termed by Giesel,) will probably prove to be an element of activity comparable with that of radium.

The radiations from these substances are invisible to the eye, but possess the properties of acting on a photographic plate and discharging an electrified body. The rays from a very active substance like radium cause many phosphorescent substances to become luminous. An ordinary X-ray screen, crystalline zinc sulphide and the minerals willemite and kunzite glow brightly when exposed to radium rays. A photographic plate is rapidly affected by bringing near a few milligrams of radium bromide, and an electroscope quickly loses its charge.

The radiations from the active bodies have been shown to consist of three distinct kinds, known as α , β , and γ rays. Unlike ordinary light-waves, the α and β rays consist of a flight of charged particles projected with enormous velocity. They differ from ordinary light, inasmuch as pencil of these rays is deflected by a magnetic and electric field. These properties of the radiations have allowed us to determine the size of the particle and its velocity of projection. Rutherford found that the α rays consisted of atoms of matter carrying a positive charge and moving with a velocity of about 20,000 miles a second. The α rays are readily stopped by matter, being absorbed by a few centimetres of air and by a sheet of ordinary note paper. The β particles, on the other hand, are far more penetrating and pass through several millimetres of aluminum or iron. The β particles differ from the α particles in carrying a negative charge and in their much greater velocity of projection. Some of them move with a velocity of over 170,000 miles per second—a speed very nearly equal to that of light. The β particle has been found by Becquerel and Kaufmann to be identical with the cathode particle produced by a discharge in a vacuum tube. It has the smallest size of any body known to science, for its mass is only about 1-1000 of that of the atom of hydrogen. The relative sizes and velocities of the α and β particles are diagrammatically shown in Fig. 1. The relative energies of motion of the particles are also shown.

The γ rays are of an extraordinarily penetrating character, readily passing through several inches of iron or lead and several feet of water. They are not deflected by a magnetic or electric field and are believed to be a type

	MASS	VELOCITY	ENERGY
α	○	—	⊗
β	•	——	•

FIG. 1.

of very penetrating X-rays. The latter are believed to consist of pulses in the ether, akin in some respects to the very short waves of ultra-violet light.

If a magnetic field is applied to a pencil of rays from radium, the rays are sorted out into the three kinds. This is shown in Fig. 2, where the magnetic field is applied at right angles to the plane of the paper. The α particles are bent to the left, the β to the right, while the γ rays proceed in a straight line without deviation. Compared with the β rays, the amount of bending of the α rays is much exaggerated in the figure, for a very strong magnetic field is required to appreciably deflect the latter. The β rays consist of particles projected with different velocities, so that some are more easily bent by a magnetic field than others. This is shown in the figure.

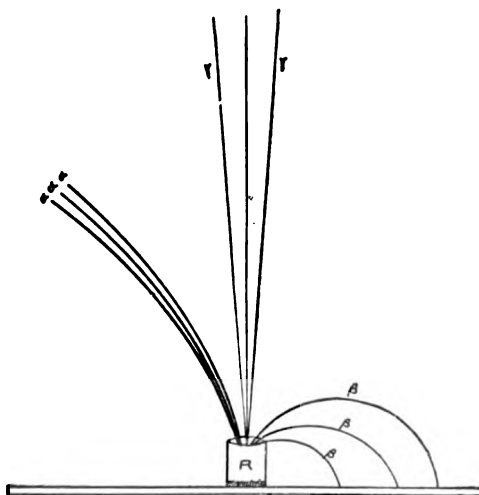


FIG. 2.

The expulsion of α and β particles from the atoms of the radioactive bodies appears to result from an explosion in some of the atoms of these substances. About two hundred thousand million of these α particles are expelled from one gram of radium bromide every second; and yet the number of atoms in a gram of radium is so enormous that this rate of expulsion can continue for several years without any

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sensible alteration or diminution of the quantity of radium.

The most important property of the α , β , and γ rays is their power of discharging an electrified body, and this property has been utilized as a means of quantitative measurements of

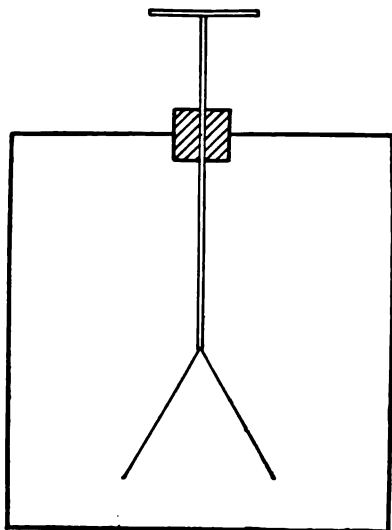


FIG. 3.

the radiations. The ordinary gold leaf electroscope, such as is shown in Fig. 3, can be used to measure radiations of extremely small intensity. A simple gold leaf is attached to a metal rod passing through an insulating cork of sulphur or ebonite. On giving a charge to this rod, the gold leaf diverges and, under ordinary conditions, the gold leaf collapses very slowly. If, however, a radioactive substance is brought near it, the charge on the system is dissipated and the gold leaf rapidly collapses.

The radiations produce a large number of positively and negatively electrified particles or ions, as they are called, from the neutral gas. If the electroscope is charged positively, for example, the negative ions are drawn into it and dissipate its charge. Under suitable conditions, the rate of movement of the gold leaf is a measure of the intensity of the radiations. A modified form of gold leaf electroscope is capable of detecting the presence of an extraordinarily small quantity of radioactive matter. One millionth of a gram of radium bromide causes the gold leaf to collapse in a few seconds, and, with care, the effect of one million millionth of a gram can be accurately determined. As a means of detection of radioactive matter in small quantity, the electroscope far transcends in delicacy even the spectroscope. The ordinary quadrant electrometer is also a very convenient instrument for measuring the small ionization produced by the radiations in the air or other gas through which they pass.

In addition to their power of giving out the three kinds of rays, radium, thorium, and actinium also possess another very remarkable property. Each of these substances continuously gives off into the air a minute quantity of gas, which is itself radioactive. This "emanation," first discovered by Rutherford in thorium,

gradually diffuses from the radioactive body into the surrounding gas and can be carried away with a current of air. The "emanations," however, only keep their power of radiating for a short time.

The activity of the emanation decreases in a geometrical progression with the time; the emanation from thorium loses half of its activity in one minute; from radium in four days; and from actinium in four seconds.

The amount of emanation obtained from these substances is a maximum when in solution; in a solid state only a fraction of the emanation produced in the substance is able to escape from it.

These emanations have been found to possess all the properties of radioactive gases mixed in minute quantity with the air. The emanations of thorium and radium behave like heavy gases and are chemically inert like the recently discovered members of the argon-helium family. The emanations can be removed from the air by the action of extreme cold. The emanation of thorium condenses at -120°C ., and that from radium at -150°C . This property of condensation of the emanation from a very active substance like radium can readily be followed by the eye. The emanation released from radium is stored with air in a small reservoir (Fig. 4). It is slowly passed through a U tube of glass, filled with fragments of the phosphorescent mineral willemite. The tube is immersed in a vessel filled with liquid air. The emanation condenses in the tube immediately below the level of the liquid air, and the radiations from the condensed emanation cause the willemite to become luminous. On removal of the tube and closing the ends, the emanation, after some time, is again volatilized and distributes itself throughout the tube, causing a uniform luminosity

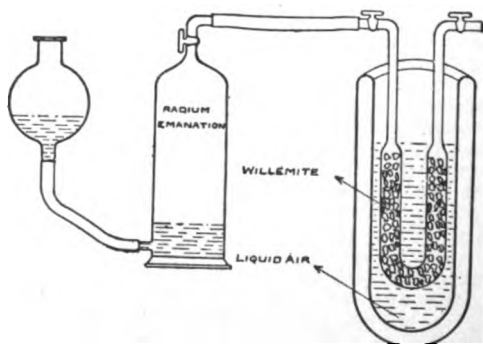


FIG. 4.

throughout it. With a large quantity of radium emanation, such an experiment is extremely striking.

Ramsay and Soddy have succeeded in isolating the emanation of radium, and found that the maximum volume to be obtained from one gram of that substance was only one cubic millimetre at standard pressure and temperature. This gas is brilliantly luminous and rapidly blackens the tube containing it. The emanation has a definite spectrum of bright lines, similar in general character to that observed for the inert gases argon or helium.

Curie and Laborde first observed the striking

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fact that radium kept itself continuously at a temperature several degrees higher than the surrounding air. The radium is continuously emitting heat at the rate of 100 gram calories per hour; that is, it would heat its own weight of water through 100° C. in one hour. Rutherford and Barnes showed that the greater part of the heating effect of radium was not due directly to the radium itself, but to the emanation continuously produced from it. This emanation was separated from the radium, and condensed in a small glass tube immersed in liquid air. The heating effect of the minute quantity of emanation thus obtained was found to be three quarters of that originally possessed by the radium. Compared with its weight, the radium emanation emits a quantity of energy more than a million times greater than that released in the most violent chemical reaction. The heating effect of the emanation is not, however, permanent, but dies away with the time at the same rate as it loses its activity; that is, it falls to half value in about four days.

If a cubic centimetre of the emanation were collected in a glass tube, it would probably give off sufficient heat to melt down the walls of the tube. It can readily be deduced that one pound weight of the emanation, after its separation from radium, would emit energy at the rate of 10,000 horse-power and, during the time that its activity lasts, would emit an amount of energy corresponding to 60,000 horse-power days. The heating effects of radium have been found to be directly due to the expulsion of α particles from its mass. Each of these particles is projected with such a great velocity that it has considerable energy of motion, which is transformed into heat when it strikes a body. These α particles are easily stopped by matter and, in a mass of radium, most of the α particles projected throughout its volume are not able to escape, but are stopped by the radium itself. Radium is thus heated by the unceasing and vigorous self-bombardment by the α particles shot out from its own mass. The heating effect of the emanation, in a similar way, is due to the energy of motion possessed by the α particles expelled from it.

The emanations all show another very striking property. If the emanation is drawn through a tube, the surface of the tube becomes coated with an invisible active deposit. This deposit can be dissolved in acids, and after evaporation of the solvent, remains behind on the dish. After removal of the emanation, the deposit gradually loses its activity but at a different rate from the emanation itself. This "excited" or "induced" activity, as it is termed, is due to radioactive matter which arises from the decomposition of the emanation. The excited activity of thorium falls to half value in 11 hours, that of radium in about 30 minutes, and that of actinium in 36 minutes.

Considerable light was thrown on radioactive phenomena by some experiments of Rutherford and Soddy that will now be considered. It was found that an intensely active substance called thorium X could be separated by a single chemical process from thorium. If some thorium nitrate is dissolved in water and ammonia added, the thorium is precipitated. If the ammonia solution is then evaporated and ignited, a very active residue is obtained, sev-

eral thousand times more active, weight for weight, than thorium itself. The thorium itself is at the same time deprived of more than half of its original activity. A very interesting result is then observed. The activity of this residue thorium X is found not to be permanent but to decay according to a geometrical progression with the time, falling to half value in four days. At the end of a month, the activity is less than 1 per cent of the initial value. At the same time, the precipitated thorium regains its lost activity, such that the sum of the activity of the thorium and thorium X together is always the same, and equal to that of the original thorium before chemical treatment. At the end of a month's interval, the thorium has nearly recovered its old value, and a new quantity of thorium X can then be obtained by the same chemical operation. This process can be continued indefinitely provided sufficient interval is allowed to elapse between each precipitation for the thorium to regain its activity. These results are very simply and fully explained on the following hypothesis. A small fraction of the thorium atoms every second becomes unstable and breaks up with explosive violence, an α particle being projected during the process. After the expulsion of an α particle, the residue of the thorium atom is lighter than before and becomes the atom of the new substance, thorium X. This substance is again unstable and breaks up with the expulsion of α particles, half of the matter breaking up in four days. In ordinary thorium, there are thus two opposing processes at work. The substance thorium X is produced at a constant rate by the disintegration of some of the thorium atoms, and at the same time this thorium X breaks up and changes into another substance. A steady state will obviously be reached when the number of atoms of thorium X, which are produced per second, is equal to the number of atoms of thorium X which break up per second. The constant radioactivity of thorium may thus be likened to the constant population of a country, where the number of births is equal to the number of deaths.

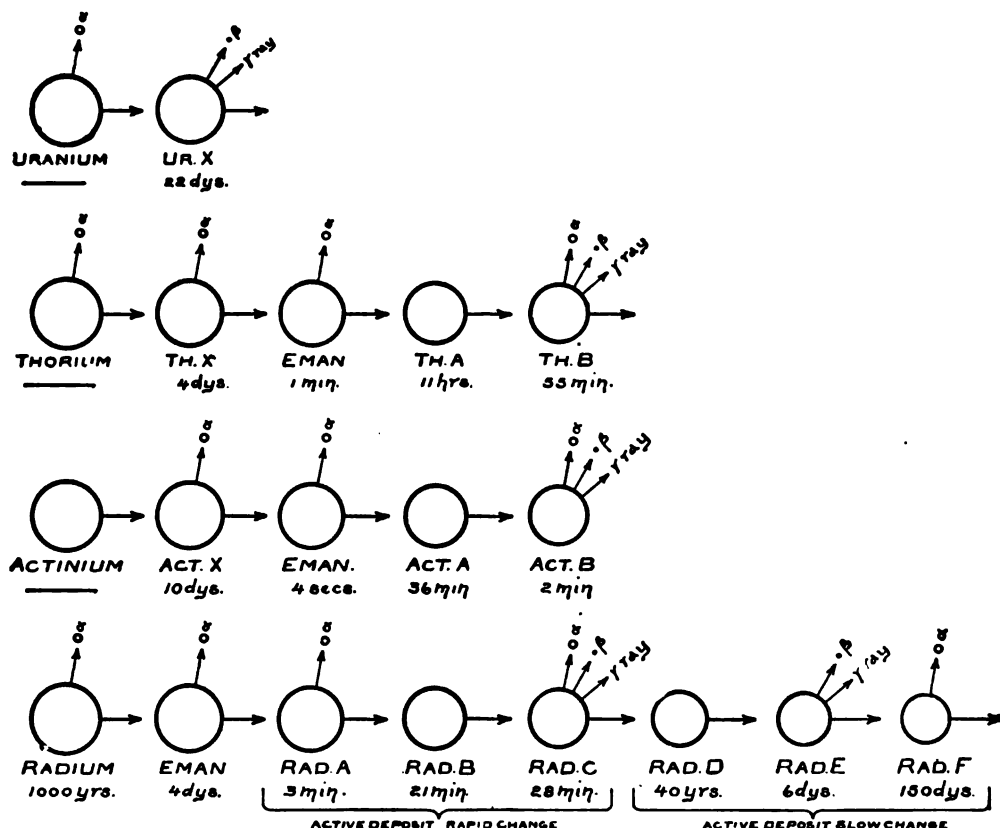
It has been found experimentally that the property possessed by thorium of giving off an emanation belongs not directly to the thorium but to its product, thorium X. The amount of the emanation is always proportional to the amount of thorium X present, and thorium freed from thorium X does not emit any emanation. This shows that thorium X is the parent of the emanation. According to the disintegration theory, advanced by Rutherford and Soddy, the atom of the emanation arises as a result of the expulsion of a particle from the atom of thorium X. In a similar way it has been shown that the emanation is transformed into the active deposit which has been found to consist of two distinct substances called thorium A and thorium B. The former does not give out rays at all, and is half transformed in 11 hours. It changes into the substance thorium B, which gives out α , β , and γ rays, and is half transformed in 55 minutes. The active deposit usually consists of thorium A and B together. These two constituents can be separated from one another by electrolysis, or the same may be done by utilizing the differences in their volatility when subjected to heat.

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These "rayless" products, of which there are now several examples, are of great interest. These substances are transformed without the appearance of any noticeable radiation. This may be the result either of a rearrangement of the parts of an atom, or may be due to the fact that the α particle is not released with sufficient velocity to produce ions in the gas. It is interesting to note that the chemical and physical properties of a rayless product can be determined by observing its effect on the succeeding product which emits rays. Thus we can learn the properties of a substance which we are unable to directly observe either by its weight or its radiations.

and the radiations which accompany its transformation are also added.

It will be seen that seven distinct transformation products have been found in radium. The active deposit of rapid change arising from the emanation consists of three substances, called radium A, B, and C, which are half transformed in 3, 21, and 28 minutes, respectively. After these products have undergone transformation, a residue of very slight activity remains. The properties of this residue have been analyzed by Rutherford, who has shown that it breaks up through three successive stages, called radium D, E and F. The substance radium D does not give out rays itself, and is transformed very



The process of analysis which has been applied to thorium has been applied with equal success to uranium, radium, and actinium. Sir William Crookes found that uranium has a product called uranium X, which is half transformed in 22 days and gives out only β and γ rays. The product actinium X was recently discovered by Godlewski. The radioactive properties of actinium are very similar, as will be seen from their stages of transformation given later. It is impossible in this short article to discuss in detail the experiments by which the presence and properties of these series of products, resulting from the transformation of the radio-elements, have been determined. The conclusions arrived at are shown diagrammatically in Fig. 5. The time for each product to be half transformed is placed below the product,

slowly—about half value in 40 years. The examination of this residue has brought to light the very important fact that radio-tellurium, and probably also polonium, are products of the disintegration of radium. The product radium F is identical with the radio-tellurium of Marckwald, for their chemical and physical properties are the same, and both lose their activity at the same rate. It has also been shown that radium D is probably the primary substance, which causes the activity observed in the radio-lead of Hofmann. The active substances present in polonium, radio-tellurium, and radio-lead are thus proved to be members of the radium family.

The products obtained from the radio-elements all possess some distinctive physical and chemical properties, which distinguish them not only from other products but also from the

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parent element. For example, radium—a solid substance with chemical properties closely allied to barium—is transformed into a gaseous substance, the radium emanation. The emanation in turn is transformed into a solid. Each of these products must be considered a distinct chemical substance. They differ from the ordinary chemical elements in the fact that they are unstable and undergo transformation into other or new kinds of matter. On account of their very limited life, these products exist in very minute quantity, and it is only in the case of a comparatively slowly changing product like the radium emanation that a sufficient amount can be obtained to measure. There is no doubt, however, that both radium D and F will ultimately be obtained in sufficient quantity to obtain their spectrum and chemical constants.

In the radio-elements, we are witnessing the transformation of matter through a series of successive stages. The products represent the halting places where the matter is able to exist a short time before it breaks down into new forms. This process of transformation is spontaneous and, as far as observation has at present gone, cannot be hastened or retarded by any physical or chemical agencies.

Since the radio-elements are steadily being transformed, the original matter must slowly disappear and be changed into other kinds. It can be calculated with some confidence that radium will be half transformed in about 1,000 years. A feebly active substance like uranium will probably take one thousand million years to be half transformed. The radio-elements apparently only differ from their products in their length of life; that is, in the stability of the atoms composing them.

A mass of radium left by itself would, in the course of 20,000 years, be almost completely transformed. Since the age of the minerals in which radium is found is known to be much older than this, it is necessary to suppose that radium is constantly produced from some other substance. The most likely parent of radium is the heavy element uranium, with which it is always found associated. Such a view has been strongly confirmed by recent investigations of Boltwood, Strutt, and McCoy. Boltwood has found that the amount of radium in different radioactive minerals, obtained from different parts of the world, is always proportional to their content of uranium. Such a relation indicates that radium is derived from uranium. If this is the case, a quantity of uranium, initially freed from radium, should in the course of time produce some radium. Such a growth of radium from uranium has actually been recorded in some recent experiments by Soddy and Whetham. The rate of production observed is, however, much slower than is to be expected if uranium passes directly into radium. The evidence is thus very strong that one element uranium produces another distinct element radium, which is quite distinct in chemical and physical properties from its parent.

In Fig. 5, we have given the series of bodies produced by the transformation of the radio-elements. But this process of transformation must ultimately come to an end and we should thus expect that the final product should be inactive, and probably consist of a known element or elements. Now the substance lead is always

found in small quantity in minerals, and it is possible that this substance may prove to be the final or end product of radium.

The radioactive minerals must be considered as nature's laboratory in which all the products of transformation of the radioactive substances will be found. Rutherford and Soddy early suggested that the rare gas helium, which is always found associated with the radioactive minerals was a transformation product of the radio-elements. This prediction was verified by some very striking experiments made by Ramsay and Soddy. They removed the emanation from a quantity of radium and collected it in a tube. A discharge was passed through this tube and the light examined by a spectroscope. After standing several hours the spectrum of helium was observed, showing that this gas had been produced during the transformation of the emanation. Here again we have an example of the production of one element helium from another.

It seems likely that the α particles which are projected from the radio-elements are in reality helium atoms, but the amount of helium produced from radium is so small and difficult to measure that it is not easy to definitely settle the question of the position which helium occupies in the scheme of transformation outlined in Fig. 5.

The helium found in radioactive minerals is thus a decomposition of radium and probably also of the other radioactive substances present in it. It seems likely that we shall be able to form a rough estimate of the age of the radioactive minerals by measuring the amount of helium found in them, since for a given amount of radioactive matter present, the amount of helium will be greater, the longer the mineral has been formed.

Although radium is found in the greatest quantity in the mineral pitchblende, it is also found distributed in minute quantity over the whole surface of the earth. This has been clearly brought out by the long series of investigations made by Elster and Geitel of the radioactivity of different soils and of the atmosphere. J. J. Thomson, Himstedt, Strutt and many others have found that the radium emanation is present in springs and in well water. Bumstead and Wheeler found that the air and surface waters of New Haven, Connecticut, was impregnated with the radium emanation. Strutt and Allan have observed that the famous Bath springs contain a considerable amount of radium emanation, and the former has also shown that the water contains a minute amount of radium in solution. A similar result has been noted for the waters at Baden and elsewhere. It has been suggested that the curative properties of these hot-water springs may possibly be due to the presence of radium or the radium emanation. This has, however, by no means been established.

The atmosphere is found to always contain a small quantity of the radium emanation. This does not come from the atmosphere itself but diffuses up from the soil or is carried up by spring water. A large amount of investigation has been carried out to determine the amount of emanation present in the atmosphere at different localities and under varying atmospheric conditions.

RADIOMETER — RADIOTHERAPY

It has been suggested that the internal heat of the earth may be, in part at least, kept up by the heat liberated by the radium and other radioactive matter present in it. Observations, that have so far been made, seem to show that the amount of radium in the surface crust of the earth is sufficient to supply as much heat to the earth as is lost by conduction to the surface from the hot interior of the earth. It is only necessary that radium should exist in the earth to the extent of four parts in one hundred million to account for the maintenance of the internal heat of the earth. The amount of radium or equivalent amount of other radioactive matter present in the earth cannot be greater than 270,000,000 tons or otherwise the earth would be growing hotter.

It is not possible to discuss here the physiological actions that are produced by radium rays. A large number of experiments have already been made and the literature of this branch of the subject is already extensive and is very rapidly growing. E. RUTHERFORD,

Prof. of Physics, McGill University, Montreal.

Radiometer, an instrument used to measure mechanical effect of radiant energy. It consists of four crossed arms of very fine glass, supported in the centre by a needle-point having at the extreme end thin disks of pith, blackened on one side. The instrument is placed in a glass vessel exhausted of air, and when exposed to rays of light or heat the wheel moves more or less rapidly in proportion to the strength or weakness of the rays.

Radiophone, an instrument that transmits or produces sound by means of radiant energy, particularly a device similar to the photophone, whose receiver is a block of vulcanite, with no telephone, the vibratory contraction and expansion being produced by the heat of the beam while vibrating, which is accompanied by an audible sound.

Radiotherapy is a term broadly used to designate the uses of the X-rays in the treatment of disease.

Scarcely had the diagnostic wonders of the X-rays been brought before the world by Professor Röntgen than X-ray operators and clinicians became cognizant of the deleterious effects which sometimes followed prolonged or frequent exposures for diagnostic purposes.

Partial or complete loss of hair over the part rayed; atrophy of the nails, and inflammations and destructive disturbances in the skin followed, varying from a simple redness, or a transient dermatitis to extensive ulcerations which healed most unkindly if at all.

It was only a step farther to adapt this little known and powerful agency to a beneficent purpose.

Within two years after Röntgen published his original paper, Freund* detailed the results of two experiments in the treatment of hypertrichosis (superfluous hair on face), in which a disappearance of the hairs followed frequent and prolonged exposures. In one of the cases reported by Freund after a number of exposures which aggregated over 40 hours, a violent and severe inflammation of the skin was set up which finally resulted in ulceration and necrosis.

The caustic action of the X-rays as seen in this case suggested to Schiff of Vienna the possibility of its use in the treatment of lupus vulgaris.

Independent of the work of Schiff and deducing his reasons from an entirely different hypothesis, Dr. Philip Jones of San Francisco as a result of the studies of the action of X-rays on a photographic plate, claimed and proved that the X-rays would cure lupus.

Dr. Jones' theory was that: the action of the X-rays on a photographic plate was a decomposing one, hence the X-rays ought to break down the highly organized lupus tissue. His results proved the soundness of his theory.

The fact that hypertrichosis and lupus, two of the most intractable diseases that bothered the dermatologist, could be successfully combated by the X-rays, naturally gave a great impetus to radiotherapy.

The already large number of X-ray investigators working along diagnostic lines quickly turned their attention to the therapeutic action of the rays and the literature soon became extensive.

Many intractable skin diseases readily cleared up under the action of the rays. Closely following the successful results in lupus, epitheliomas or skin cancers, rodent ulcers, and new growths of that type showed the favorable results of this treatment.

The breaking down of these highly developed tissues naturally led to the treatment of ulcerating breast cancers, scirrhus or hard breast cancers, and finally the attempt to eradicate internal cancers, with the results at present still in doubt. Accompanying many of the conditions treated was pain.

It soon became recognized that after a certain number of treatments the pain was oftentimes materially decreased, and in some instances entirely disappeared, hence it naturally followed that the X-rays were used in many painful affections of the nerves, neuralgias, sciaticas and for the relief of pain in inoperable cancers.

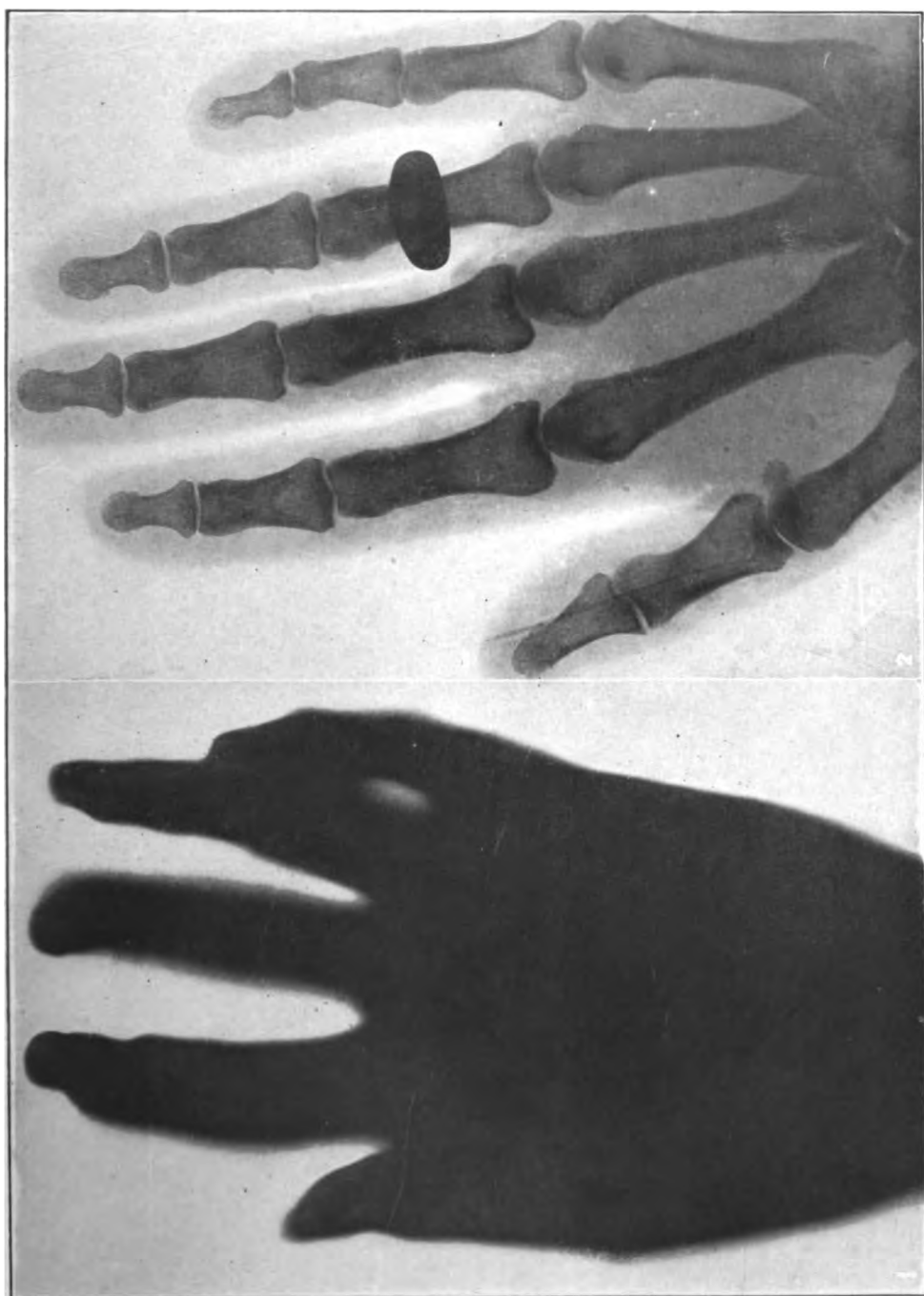
From an observation of the action of the X-rays on cancerous glands, treatment of enlarged glands from other causes was instituted and soon favorable results were recorded in cases of tubercular glands, Hodgkins disease, spleno-medullary leukemia and many allied conditions. Tuberculosis in all its varied manifestations soon was given a thorough trial. The results were eminently satisfactory in some forms, but disappointing in consumption and diseases of the bones and joints.

Having attempted to trace the beginnings of radiotherapy and the investigations which led up to it: How the action of the rays in certain conditions gradually and methodically paved the way for its employment in others, it might be advantageous here to take up the means and methods whereby these results are obtained and the protection and safeguards necessary for their successful attainment.

Apparatus.—Any form of apparatus that can successfully develop Röntgen rays may be used in radiotherapy.

The three principal styles in use are (1) the induction coil, (2) the static machine, (3) the height frequency or Tesla apparatus. The last named is so seldom used that a discussion of its merits may be dismissed.

*Wiener Med. Woch. 1897.



1. Radiograph of the human hand (dead) made by radium.
2. Radiograph of the human hand (living) made by "X" rays.

RADIOTHERAPY

Some operators prefer the static machine to the coil and claim better results for the former, while workers with coils claim the opposite.

Most men who have an opportunity to employ both recognize no great difference. It is probably true that more inefficient work is done with static machines than with coils because many static machines employed fail to develop sufficiently heavy electrical discharges to satisfactorily illumine a practical tube while capable of doing satisfactory static work. Most coils employed are sufficiently large to overcome this difficulty.

A great many factors are present in determining the intensity and quality of the rays. The amperage must be low, between one and four amperes, but the voltage may range from 12 to 110 volts.

Tubes.—In radiotherapy the tube is one of the most essential elements that control results. The character of the tube will largely be governed by the results sought. Tubes invaluable for the treatment of certain conditions are useless for the treatment of others. For hypertrichosis a rather low tube with short penetration accomplishes the most successful results, because here we seek an absorption of the rays around the hair follicles. The same is true of any thin-surfaced skin disease. But in treating morbid conditions of the deeper parts a tube is needed with a higher vacuum, because here we aim to have the rays penetrate the skin unabsorbed and act on the affected parts underneath.

There are in use three principal styles: (1) The unregulated X-ray vacuum tube. (2) The tube with a regulated attachment, whereby the vacuum of the tube may be lowered when it becomes too high, by heating a metallic needle which projects from the tube. This needle upon being heated liberates gases in the tube which lower the vacuum. This style of tube has a much longer life than a tube of the preceding style, and is quite satisfactory for radiotherapeutic work. (3) The highest type of tube is the one with the self-adjusting vacuum; a tube under absolute control even when excited. This tube does excellent work, is essential for the finer grades of radiographic work, but it is costly, punctures more readily and its advantages in radiotherapy do not compensate for its added cost. There are various special tubes manufactured for the treatment of special parts, as the larynx, vagina, rectum. These have their advantages.

Distance.—The distance of the tube or the cathode from the part to be treated varies with the conditions to be treated and the character of the tube. In those diseases where it is desirable to set up an action in the skin quickly, the tubes may be placed so that the outside of the glass is within two or three inches of the part treated. When treatment is to be continued for a long time and an inflammatory action is guarded against, the tube may be removed 12 to 15 inches.

Protection.—Most operators at the present time use a metallic protection to the normal parts, either lead or tinfoil. Grounded aluminum shields have been used, but they are unnecessary. Liquid paraffine and substances with an ointment base have been tried, but they do not offer sufficient protection. Many men in treating recurrent cancers place the tube at some

distance from the patient, and use no protection. This has the advantage that widely infected areas are acted upon.

Exposures.—Exposures may be made every day, every other day, twice a week or by Kienböck's* method, which seeks to accomplish a therapeutic effect oftentimes with a single exposure from a heavy coil and an intense light. When given daily, treatments are generally short, five minutes. The generally accepted plan is to expose the patient three times a week from 8 to 15 minutes, varying with the condition to be treated. It is practically accepted that there is an idiosyncrasy among some persons to the influence of the rays, and the most cautious operators give a preliminary exposure to determine this susceptibility to X-ray action.

Dermatitis.—There is no more debatable question in the whole realm of X-ray work than the question of the X-ray burn. A discussion of the pathology of X-ray dermatitis is foreign to the subject at hand; if interested the reader is referred to the works of Williams, Pusey and Caldwell, and the experiments of Prof. Elihu Thomson and others. It is sufficient to know that in the treatment of many diseased conditions it is wholly unnecessary to set up a dermatitis. Lupus, syphilis, cutaneous cancer and the malignant ulcerations can be entirely healed without producing inflammation of the skin beyond a slight redness or a tan. That this is so entirely disposes of the theory that the action of the X-rays in curing disease is caustic or escharotic. While it is wholly unnecessary to produce a burn to cure, in many cases haste is so imperative that in order to quickly get a patient under the influence of the rays all caution must be set aside.

Indications for Radiotherapy.—The following classification is given by Pusey†: (1) The effect in causing atrophy of the appendages of the skin; (2) their destructive action upon organisms in living tissues; (3) their stimulative action upon the metabolism of tissues; (4) their power of destroying certain pathological tissues; (5) their anodyne effect.

Under one class may be included the action of the rays in removal of superfluous hair or in alleviating conditions due to parasitic affections of the hair or its follicles: hypertrichosis, syphilis, favus, tinea-tonsurans, tinea-barbæ. In this class of cases the results of treatment are completely curative. The removal of superfluous hair from ladies' faces (complete patches) during one course of treatment is so far superior to the long, tedious, painful method of destroying each individual hair follicle by the electric needle that it requires no comment. Sometimes, if the reaction is not sufficiently severe, the hair may recur in a lessened amount, but a second series of treatments usually will produce a permanent cure.

Another group of cases would include the inflammatory diseases of the skin: Lupus-erythematosus, acne, chronic indurated eczema, lichen planus, psoriasis and affections of that class. In this group are many diseases, the medical treatment of which is entirely satisfactory. The most intractable and unsatisfactory condition in this class is probably lupus erythe-

*Interstate Med. Journal, 1902, ix, pp. 1-60.

†Pusey & Caldwell, "The Röntgen Rays in Diagnosis and Therapeutics."

RADISH

matosis. This disease is characterized by its tendency to remissions, and, unfortunately, it retains its characteristics when treated by the X-rays. There have been many cases of lasting cures, but that there are many other cases which recur after recovery seems probable, and some that radiotherapy does not beneficially affect.

There are many diseases which are caused by the action of bacteria in the skin, and subcutaneous tissues, in which there are obtained most brilliant, positive and curative results by the action of the Röntgen rays. Although the evidence is conflicting, yet it is generally accepted that the X-rays exert little or no bactericidal power on germs in culture media, but it is just as positive that the X-rays most powerfully affect diseased tissue containing germs. Whether this action is due to a stimulating effect upon the tissues themselves, making them a less receptive host for the bacteria, or whether it acts directly and destructively on bacteria and their products in living tissue, is still *sub-judice*.

The most remarkable results obtained in this class of cases are in lupus vulgaris. Before the epoch-making work of Finsen, of Copenhagen, the treatment of lupus vulgaris was most discouraging. The most persistent and continuous treatment, from cauterizations to extensive plastic work of the surgeon, could only for a time arrest the slow but steady destructive ulcerations. Some few cases were cured, but the percentage of recoveries was small, until Finsen showed his lasting cures by the ultra-violet rays. The treatment of Finsen leaves little to be improved upon so far as results go. But the treatment is unsatisfactory because of the expensive equipment, duration of each treatment, pain during treatment, and time required to effect a cure: it sometimes taking a year of almost daily treatment to eradicate a patch of an inch.

The results of X-ray therapy seem equally as good as Finsen's, while 15-minute treatments, 6 to 20 times, and given every other day, accomplish the same results. In treating lupus by means of the X-rays, the most lasting and successful results are obtained in the deeply ulcerated cases by establishing a severe dermatitis. While in the surface inflammations we may obtain a cure without producing the slightest effect on the surrounding normal skin.

At the present the X-rays seem to offer hope of a permanent cure in many of the non-malignant glandular enlargements, where it acts by breaking down tissues of low vitality without injuring the healthy connective tissues. Tubercular glands in the early stages show a fair percentage of cures. Hodgkins disease—an almost universally fatal condition—has shown many authentic cures, and recently Senn and others report cures of spleno-medullary leukemia. Care must be taken not to break down the glands too rapidly, as the large amount of decomposition products with the toxine of the disease thrown rapidly into the circulation sometimes produces severe systemic disturbances.

The consideration of the treatment of new growths, and more especially cancer and sarcoma, must necessarily be brief. The X-rays may be used in the treatment of new growths for its palliative, curative or anodyne effect. The

results of the X-ray treatment of sarcomas seem to point not to a curative but a retarding effect. For the better understanding of the cancerous conditions we may divide the subject into the epitheliomas or skin cancers and the subcutaneous cancers, including those which are beneath the tissues and cancers of the internal organs.

For most of the skin cancers X-ray treatment should be the treatment of election. Where there is no disease in the glands or other organs, treatment of a well-defined skin cancer by the X-rays is curative. Sufficient time has elapsed since the early reported cases to induce the belief that the cures are lasting.

Cancers of the tongue and mucous membranes are seldom successfully treated by the X-rays. In these conditions growth is very rapid, and death usually inevitable after any treatment. And it may be considered as an axiom, in X-ray therapy, the more chronic the disease the more likely the cure. At the present time and with our present apparatus and experience the cure of subcutaneous cancers appears very doubtful. Early excision still offers the best chance to cure, but it is in these cases that have been operated upon that much good can be done by radiotherapy subsequent to operation. Treatment of subcutaneous cancers by the X-rays prior to operation did not yield the results expected, but treatment of these cases after operation will forestall an oncoming recurrence and may possibly prevent it altogether. Here the results are most satisfactory. In the advanced cases of the disease—the inoperable cases—much can be done in prolonging life and in curing up ulcerations, retarding the disease, and controlling pain by systematic X-ray treatment.

JOHN A. LEE, M.D.

Radish, several species of herbs of the order *Crucifera*. The common garden radish (*Raphanus sativus*) is thought to be a native of Asia, but is not known in a wild state. It is cultivated for its edible roots, which in various varieties may be red, white, gray, brown or black, and vary in form from turnip-shaped to parsnip-shaped. They reach edible maturity in from three weeks or less when forced. Radishes thrive best in rich, light, well drained sandy loam. Out of doors the seed may be sown as soon as the soil can be worked, since the plants are very hardy. The seeds may be dropped about an inch apart, covered an inch deep, in rows a foot asunder in beds by themselves, or, as in market garden practice, may be sown between slower-growing crops, such as carrots, cabbage or peas. Sometimes they are even sown with the seed of parsnips, onions and other crops that are either slow to germinate or that are very inconspicuous when they first appear. They then serve to indicate the positions of the rows, so that cultivation of the other plants may begin much earlier; they must then be removed promptly to prevent injuring the main crop. For succession, the seed should be planted at intervals of a week or ten days. Winter radishes are sown from midsummer to early autumn, and when cold weather arrives are stored in pits or cellars like other roots. Clean cultivation is essential. A Japanese species (*R. caudatus*) is popularly cultivated in Asia for its long pods which are eaten raw or pickled. It is known as the serpent or rat-tailed radish. The

RADISTCHEFF — RADIUM

Pods are often a foot long. The roots are small, hard and inedible. The sea radish (*R. maritimus*) is more pungent than the garden species and is little known in American gardens. Horseradish (q.v.) belongs to a different genus, *Cochlearia*. Many of the insects which feed upon cabbage, turnip, mustard and related plants also feed upon the radish. The best known is the radish maggot which is the larva of a brown fly (*Phorbia brassicae*). The maggots tunnel in the fleshy part of the root and injure it for human food. Applications of fertilizers, especially quickly soluble ones, and rotation of crops have been recommended as preventives. Consult, Bailey, 'Cyclopedia of American Gardening' (New York, 1900-2).

Radistcheff, Alexander Nikolaievich, Russian author: b. Moscow 1749; d. there 1802. He was descended from a noble Russian family, and after spending several years at court as a page, was sent to be educated at the University of Leipsic. He returned to Russia in 1771, and obtained a position in the department of customs. He had been deeply impressed during his absence by the writings of the French philosophers of the time, and in 1790, under the influence of his liberal sentiments, he wrote his famous 'Journey from Saint Petersburg to Moscow,' patterned somewhat after Sterne's 'Sentimental Journey.' This work is a most striking picture of Russian serfdom as it existed at the time, and contains a plan of emancipation, all the more bold for its appearance in a period of reaction. The author was sent to Ilimsk, in the government of Irkutsk, by the Empress Catharine, but was allowed to return to Russia in 1796. He was made a member of the legislative commission in 1801.

Radium (from Latin, *radius*, ray), symbol Ra, discovered in 1898 at Paris by Professor Pierre Curie and Mme. Sklodowska Curie in collaboration with M. Bémont. It is the most important and most interesting of the radioactive substances which have thus far been found in uraninite or, as it is termed in popular parlance, pitchblende. (See PITCHBLEND.)

Radium, which resembles common table salt in appearance, is a new element having an atomic weight of 225. In its chemical and other characteristics, it resembles barium, with which it is closely allied and which latter substance has an atomic weight of 157.

Radium is a metal, and while it is never prepared in a metallic form, it readily could be so produced, although only at a great loss involving perhaps thousands of dollars, but it would not last in this form, being very unstable and, like sodium, immediately oxidized and destroyed. In the form of a chloride or a bromide, in which forms it is usually prepared, it lasts indefinitely without any apparent physical or chemical change. Professor Henri Becquerel has stated that if a square centimetre of surface was covered by chemically pure radium it would lose but one thousandth of a milligram in weight in a million years time. Similar statements have been made, by Professor J. J. Thomson and others, tending to show that, notwithstanding the enormous amount of energy given off by radium in producing its remarkable chemical, physiological, luminous, thermal, elec-

trical, and other effects, there is no appreciable loss in weight nor any microscopic, spectroscopic or chemical change in the original body.

Among the remarkable characteristics of this extraordinary substance may be cited the following:

It gives off three distinct types of rays named after the first three letters of the Greek alphabet, Alpha, Beta and Gamma. The Alpha rays constitute about 99 per cent of all the rays and consist of positively electrified particles. These were at first supposed to be uninfluenced by magnetism, but Rutherford has recently shown that with a powerful magnetic field about 30 per cent of the rays are deflected and in a powerful electric field as high as 45 per cent are deflected. The deflection is in the opposite direction to the Beta rays. The mass of the Alpha body is about twice that of the hydrogen atom. They have scarcely any penetrative power and are readily absorbed in passing through a sheet of ordinary note paper or a few inches of air.

The Beta rays, which are the most spectacular of the rays and have been given the largest amount of attention by investigators, consist of negatively charged particles or "corpuscles" approximately one two-thousandth the size of those constituting the Alpha rays. In every particular these rays resemble the cathode rays produced by an electric discharge inside of a highly exhausted vacuum tube, although they work at a higher velocity than the cathode ray particles. They are readily deflected by a magnet, discharge electrified bodies, affect photograph plates, stimulate strongly phosphorescent bodies and are of great penetrative power.

The Gamma rays are very few in number, so few in fact that they have received little attention thus far. They are almost impossible to detect save in a highly radioactive substance such as radium. They resemble in many respects very penetrative X-rays produced at the moment of the expulsion of the Beta or cathode rays. They are uninfluenced by magnetism, pass in straight lines at great speed and possess remarkably penetrative properties, even affecting a photograph plate through a foot of iron.

It gives off a gaseous emanation, as does thorium, which is also a powerfully radioactive substance. (See THORIUM.) The emanations possess all the properties of gases: diffusing through air and porous substances such as paper, they can be stored like ordinary gas and can be condensed at a temperature of liquid air, and are unaffected by chemical reagents.

It ionizes the air or makes the air (in fact, any gas through which it passes) a conductor of electricity.

It discharges negatively electrified bodies.

It is, according to Mme. Curie, the first example of a body which spontaneously charges itself with electricity.

It acts upon the chemical constituents of glass, porcelain and paper, giving them a violet tinge, changes white phosphorus into yellow, oxygen into ozone, affects photograph plates and produces many other curious chemical changes.

It imparts radioactivity to everything surrounding it. (See RADIOACTIVITY.)

RADIUM

It destroys the germinative power of seeds.

It likewise destroys various micro-organisms and checks the growth of others.

It has given encouraging results in the treatment of certain classes of disease, but it is too early as yet to state positively to what extent it can be used in medicine and surgery. Owing to its scarcity and high cost, but few have been able to experiment with radium, and insufficient time has elapsed to prepare specifications for its use or to state with positiveness what its limitations are in this field. It has produced paralysis and death in fish, mice, rabbits, guinea pigs, and other animals, and would undoubtedly similarly affect human beings. Professor Curie has told the writer that he would not care to trust himself in a room with a kilo (2.2 pounds) of radium, for it would destroy his eyesight, burn all the skin off his body, and probably kill him, and he has recently said that a single gram of chemically pure radium could destroy the life of every soul in the city of Paris, provided they were separately and properly exposed to its influence.

It retards the growth of certain forms of life such as larvæ, so that they do not pass into the chrysalis and insect stages of development, as their companions do; but remain larvæ.

It causes other forms of life, such as very young tadpoles, to become monstrosities or abnormalities. It causes the hair of mice to fall out, and they run about without a hair on them, and, if the radium is placed closer, the mice are paralyzed and killed. On the other hand, it causes a growth of the hair or fur of rabbits when they are exposed to radium placed at a proper distance.

It has produced partial paralysis in the "Torpedo Galvani," or electric ray, on a comparatively short exposure, so that it could no longer give its powerful electric shocks.

It has frequently caused serious burns and ulcers when placed near the flesh for a short time, the rays acting through the clothing of the person exposed, and, in fact, to a greater or less degree passing through everything, solids, liquids and gases, even through many inches of steel.

It is not affected by great extremes of heat and cold in respect to its radioactivity, but varies in the degree of its luminosity.

It gives off but little light, its luminosity being largely due to the stimulation of the impurities in the radium by the powerful but invisible radium rays.

It affects photographic plates placed in opaque envelopes, which plates, so protected, would not be affected even though exposed to bright sunlight for 24 hours, as ordinary light does not penetrate opaque substances. Ordinary light is also reflectable, refractable and polarizable, whereas the Becquerel rays coming from radium do not possess these characteristics. By reason of the foregoing the pictures of objects produced on the negative by radium and other radioactive substances cannot properly be called photographs; they are in reality radio-graphs.

It has a temperature, as discovered by Professors Curie and Laborde, of between five or six degrees Fahrenheit above its surroundings and will melt its own weight of ice every hour for an indefinite period.

It may prove ultimately that the alchemists of old were not so far wrong in their belief in the transmutation theory, for Sir William Ramsay and Professor Soddy have demonstrated that helium, one of the new elements discovered in the atmosphere by Professor Ramsay and which constitutes the gas most prevalent in the sun's atmosphere, is shown by the spectroscope to be present in the gaseous emanation from radium, and Professor Ramsay states that eventually the entire emanation turns into helium, proving, so he claims, that one element can change into another.

It constitutes an absolute test of the genuineness of a diamond, causing diamonds to phosphoresce strongly when brought near the radium, whereas imitation stones will glow but little, if at all.

It not only imparts radioactivity to cardboard, metals, etc., but such substances made radioactive on being placed near the radium can be stimulated by the vibrations from sunlight, burning magnesium, ultra-violet light, an electrical brush discharge, etc., so that the object will glow beautifully in the dark. Freshly fallen snow and rain and certain mineral springs and baths are radioactive; even the leaves of trees, blades of grass; in fact, practically everything in nature may be said to possess this property in some degree, and a fine wire charged with negative electricity of approximately 500 volts will become coated with radioactive properties, collected from the atmosphere, and this deposit can then be scraped from the wire and used.

It imparts radioactivity to anything adjacent to it, and the coating thus formed is so adhesive that water cannot wash it off, although it can be removed with ammonia.

It also imparts a beautiful carmine color to a flame in which it is burned.

It stimulates powerfully various mineral and chemical substances near which it is placed, and, substances such as willemite, sulphide of zinc, etc., in a powdered form, having a little radium mixed with them, are thus made to glow very brightly in the dark for an indefinite length of time, and there is promise in this direction of securing an efficient illuminating agent without flame and without appreciable heat.

It is found in a smaller percentage in pitchblende and other radioactive substances, according to Prof. J. J. Thompson, than the percentage of gold which is found in sea water.

It takes, says Professor Curie, 5,000 tons of uranium residues, that is, pitchblende, after the uranium has been extracted, to make a kilo (2.2 pounds) of radium, and this product by no means radium in its purest state.

It formerly took three months, and even now takes about one month, to work the process, and it costs about \$2,000 a ton to refine the uranium residues.

A bibliography of radium, even at this early date, would be very extensive; among the publications containing the most important contributions are *The Phil. Mag.*, *Comptes Rendus*, *Ann. der Physik*, *Revue Gen. des Sciences*, *Nature*, *Jour. de Phys.*, *Soc. Française Phys.*, *Bulletin*, *Chem. News*, *Phys. Ges. Verk.*, *Phys. Zeit.*, *Science Abstracts*, *Wien. Ann.*, *Ber. Dtsch. Chem. Ges.*, *Proc. Royal Soc.*, etc.

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P. Curie



M. Curie

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THE DISCOVERERS OF RADIUM

RADIUS — RAEBURN

Ra'dius, the bone of the fore limb of vertebrate animals, which, as in man, when the arm is laid flat, with the palm upward, lies to the thumb side of the limb. This side is therefore termed the *radial* side of the limb, in contradistinction to the *ulnar* or opposite side, so named from the ulna or neighboring bone, which, with the radius, constitutes the forearm. See **ARM**.

Radius in geometry. See **DIAMETER**.

Radius Bar, or **Radius Rod**, one of the guiding-rods in a parallel motion, jointed to the connecting links, to counteract the vibratory motion communicated by the beam by guiding the links so that the head of the piston rod may reciprocate in a line sensibly straight.

Radius of Curvature. See **CURVE**.

Radius Vector. See **MATHEMATICS**.

Ra'dix. See **ROOT**.

Radom, rā'dōm, Russian Poland, (1) capital of the government of same name, 65 miles south of Warsaw, and one of the best-built provincial towns. Its special features are an ancient church and convent. Its manufactures are of tin, oil, vinegar and leather. Two fairs are annual attractions. Pop. 25,000. (2) The government covers an area of 4,768 square miles, and has a pop. of about 830,000.

Radowitz, rā'dō-vits, **Joseph Maria von**, Prussian statesman: b. Blankenburg, Germany, 6 Feb. 1797; d. Berlin, Germany, 25 Dec. 1853. He was of a noble Hungarian family, and in 1813 entered the Westphalian army as an officer. In 1823 he entered the Prussian service, and in 1830 became chief of the general staff of artillery and a leader of the anti-revolutionary party. He subsequently held diplomatic posts at Carlsruhe, Darmstadt, and Nassau, was the confidant and adviser of King Frederick William IV., and after the revolution of 1848 supported the efforts of Prussia to give a constitution to Germany. He wrote several works, mainly political, which include: 'Gespräche aus der Gegenwart über Staat und Kirche' (1846-51); (Gesammelte Schriften' (1852-3); etc.

Radziwill, rād'zē-vil, ancient Polish family. Among its most famous members are: (1) Nicholas the Black, son of John the Bearded, and palatine of Wilna; d. 1567. King Sigismund Augustus gave him the command, in 1552, in the war against the Polish knights. He also commanded in the war against Russia in 1561. Having become a convert to the Reformation, he procured a translation of the Bible into the Polish tongue (Biblia swieta, Brzesc, 1563). (2) Christopher II., military governor of Lithuania and palatine of Wilna. b. 1585; d. 1640. After the death of Sigismund, in 1632, he undertook the defense of the Protestants at the Diet of Warsaw and obtained complete toleration for them. Enjoying the confidence of Wladislaw IV. he commanded in the war against Russia. (3) Boguslaw, Prince Radziwill, son of Prince James and Sophie Elizabeth, margravine of Brandenburg, was governor in Prussia, 1657-69, and rendered important services in endowments to universities and schools. (4) Charles, Prince Radziwill, palatine of Wilna and grand-commander of Lithuania: b. 1734; d. 1790. He was the enemy of Czartoryski and the Russians, and an adherent of the Saxon party. He was an ardent supporter of the Confederation of Bar,

and was several times exiled. For three years he was a member of the constituent diet at Warsaw. Consult 'Die historische Stellung des Hauses Radziwill' (1892).

Rae, rā, **John**, Scottish explorer: b. near Stromness, Orkney Islands, 30 Sept. 1813; d. London 22 July 1893. He studied medicine at Edinburgh, became surgeon in the Hudson's Bay Company's service in 1833, and from 1835 till 1845 was the company's resident surgeon at Moose Fort. In 1846-7 he made his first exploring expedition, covering 700 miles of the northern coast of America. He then went to London, and in 1848-9 accompanied Sir John Richardson in his Franklin search in the Mackenzie and Coppermine region. He conducted two expeditions in 1851, during the first of which he explored a large part of the coast of Wollaston Land. During the second he traveled a distance of over 5,000 miles in eight months, and explored much of the coast of Victoria Land. In 1853-4 he again conducted an expedition, and discovered the first traces of Franklin's fate, for which the party received the government grant of £10,000. He also proved King William's Land to be an island. He published 'Narrative of an Expedition to the Shores of the Arctic Sea in 1846-47' (1850).

Rae, W. Fraser, English author: b. 1835; d. 22 Jan. 1905. He was educated at Heidelberg and was admitted to the bar in 1861. Among his works are 'Newfoundland to Manitoba' (1881); 'Facts about Manitoba' (1882); 'Miss Bayle's Romance,' a novel (1887); 'An American Duchess' (1891); 'Egypt To-day' (1892); 'Biography of Sheridan' (1896).

Raeburn, rā'bērn, **Sir Henry**, Scottish painter: b. Stockbridge, near Edinburgh, 4 March 1756; d. there 8 July 1823. He was left an orphan at an early age, and was apprenticed to a goldsmith, who, perceiving his talent for drawing, encouraged him in his ambition to be an artist. The favorite portrait painter in Edinburgh at that time was David Martin, who was the only instructor Raeburn ever had. He formed his style, however, by copying in color, mezzotints from the paintings of Sir Joshua Reynolds, and while he learned the chiaroscuro of that master he never attained his almost Italian richness and solidity of coloring. His drawing was correct, but unfortunately acting under the idea that a portrait was to be viewed at some distance above the level of the eye, he foreshortened the forehead and brought forward the nostrils and lower jaw. Thus Sir Walter Scott complained that his portrait by this artist caused him to look "clownish and jolterheaded." Acting on the advice of Reynolds, Raeburn spent two studious years in Italy (1785-7) which resulted in a marked improvement in his coloring, which had previously been thin and undecided. Wilkie actually wrote from Spain that the execution of Velasquez reminded him of Raeburn. His 'Portrait of Mr. William Forsyth' in the New York Metropolitan Museum is a fair specimen of his style and there are two pictures of his in the Lenox Library. Another fine portrait may be seen in the Art Museum, Worcester, Mass. He confined his serious artistic efforts entirely to portraits and painted every eminent Edinburgh man of his day.

Raff, *räf*, Joseph Joachim, Swiss composer: b. Lachen, Switzerland, 27 May 1822; d. Frankfort-on-the-Main 24 June 1882. He was educated at Wiesenstetten in Württemberg and at the Jesuit Lyceum in Schwyz, and gained the notice of Mendelssohn and Liszt. In 1850 he removed to Weimar in order to be near Liszt, and his opera 'König Alfred' was shortly afterward produced at the Court Theatre there with great success. In 1877 he was appointed director of the Conservatoire at Frankfort, a position he occupied until his death. He was an indefatigable worker, his compositions numbering over 200, and his reputation rests chiefly upon his symphonies, among which are: 'Im Walde'; 'Lenore'; 'An das Vaterland'; etc. He was also very successful as a song-writer, and a notable composer of instrumental pieces, but his three operas were less successful. Though not confining himself to any one style of composition he was a supporter of the Wagner school.

Raffaello, *rä-fä-él'lo*. See RAPHAEL.

Raf'ia. See FIERRE.

Raf'finose, the name given a plant sugar derived from the particular species of eucalyptus trees growing in Tasmania.

Raffles, *räf'lz*, Sir Thomas Stamford, English colonial administrator: b. at sea, off Point Morant, Jamaica, 5 July 1781; d. Highwood, near London, England, 4 July 1826. He was employed in the East India House as a clerk when 14, soon attracted attention by his ability and in 1805 was appointed assistant secretary at Penang. He mastered the Malay language while on the voyage and in 1807 was appointed secretary and registrar of the recorder's court. He visited Malacca in 1808 and in 1810 went to Calcutta where he met Lord Minto, the governor-general, and by his advice the expedition against Batavia was fitted out in 1811. He accompanied Lord Minto to Java in that year and after its capture from the Dutch became its lieutenant-governor, an office which he held for five years. His administration was eminently wise and successful; he retained the Dutch colonial laws, but abolished forced labor and instituted marked improvements in taxation and the administration of justice. He returned to England in 1816 when the island was given up to the Dutch, was knighted and commissioned by the prince regent to proceed to Holland to confer with its king in regard to the government of Java. In 1818 he was appointed governor of Benckulen in Sumatra, where he found many abuses existing. He abolished slavery, reorganized the government of the colony, founded schools, and otherwise greatly improved the condition of the island. He explored with Joseph Arnold the interior of the island and discovered the great fungus named in their honor *Rafflesia Arnoldi*. Ill health compelled his return to England in 1824 and on the voyage the ship caught fire, destroying his natural history collection, manuscripts, drawings and notes valued at \$100,000. He held no further public office. He published: 'History of Java' (1817); and 'Malayan Miscellanies' (1820-2). Consult: Lady Raffles, 'Mémorial of Sir T. S. Raffles' (1830); Egerton, 'Sir Stamford Raffles' in 'Builders of Great Britain' series.

Raffie'sia, an East Indian genus of parasitic plants, reduced to apetalous dioecious flowers, and named after Sir Stamford Raffles, the discoverer. *R. Arnoldi* was the first species discovered, in Sumatra. It is a gigantic flower, springing from the roots or stems of *Vitis (cissus)*, three feet in diameter, and consisting of a globular central cup, containing either the ovary, or the numerous stamens, crowned by a ring, and the five-lobed calyx, fleshy, and flesh-colored, blotched with pink and yellow inside, and with brownish or bluish scales exteriorly. The whole flower sometimes weighs 15 pounds. It remains expanded for a few days only, and then decays, emitting a putrid odor that attracts carrion-loving flies, which probably assist in cross-fertilization. The fruit is a brown, rough surfaced nut, holding innumerable seeds. Certain Javanese species are valued there as powerful styptics.

Rafinesque-Schmaltz, *rä-fë-nësk'* smältz, Constantine Samuel, American botanist: b. Galatz, Turkey, 1784; d. Philadelphia, Pa., 18 Sept. 1842. He was of French-German parentage and was sent to America in 1802 where he made botanical investigations in Pennsylvania and Delaware and in 1805 returned to Turkey with botanical specimens. While sailing for the United States in 1815 he was shipwrecked off the coast of Long Island and lost his collection of 20 years. He settled permanently in the United States in 1815, and was made professor of botany in Transylvania University, Lexington, Ky., in 1818. Later, after lecturing in various places, he removed to Philadelphia. He was a man of wide learning, but his work is in many instances rendered confusing by his insatiate desire for novelties, and though evincing keen insight is frequently inexact. His publications include: 'Ancient History, or Annals of Kentucky' (1824); 'Medical Flora, etc., of the United States' (1828-30); 'A Life of Travels and Researches in North America and South Europe' (1836); 'Pleasures and Duties of Wealth' (1840); etc.

Raft, a floating platform, usually composed of wooden logs or planks, fastened together by nails, spikes or cordage, and used either as a vehicle of travel and for the carriage of goods, or more generally for the purpose of transporting by river, lake or sea the materials composing the raft from the place of its construction to a market for sale. In all probability the raft was the first human method of travel on water, next to floating on a large branch or tree-trunk, the use of which would naturally suggest the raft, just as a raft, with sail of skin or other material raised to catch the wind, would suggest the first rude sail boat or ship. Rafts have been in use in all historic ages, and doubtless far back in the prehistoric period, but they reached their most general use after the settlement of North America, when the vast forests were being cleared by settlers, and the raft offered almost the only method by which the pioneer on the Ohio or Mississippi could reach the settlements on those rivers, dispose of his surplus products, and buy some of the comforts and perhaps luxuries to be obtained in the towns. The steamboat has almost entirely done away with the raft as a means of travel, but rafting is still the chief method of conveying

the lumber product of northwestern forests to market, and immense rafts are sometimes sent by sea from Maine to New York or Boston. On the Pacific coast also the rafting business is most extensive. In the fall of 1902, a monster raft 700 feet long, 53 feet wide, 12 feet from the water's edge to the top, and drawing 22½ feet of water was safely towed 700 miles from Columbia River to San Francisco. The logs were 120 feet long, and from 12 to 20 inches in diameter, and there were in all 7,000 pieces, valued at \$60,000. The construction of a raft of this size is a vast undertaking. A great "cradle" of heavy timbers is built on a slough connected with the Columbia River. A row of piling is driven in deep water, and the frame of the cradle floats up and down on the row of piling, and is held in place by it. A large scow with a derrick is anchored beside the cradle. Log-booms or small rafts are towed to it, and the logs are lifted by the derrick into the cradle, where they are fastened with chains and cables, from 80 to 100 tons of chain being used on one raft. When the raft is finished the keys that held the parts of the cradle together are drawn, the side of the cradle is pulled away, and the raft floats out on the water. Tugboats draw it into and down the Columbia, and out to sea on its voyage to the Golden Gate.

Fire-rafts have been used in ancient and modern wars to destroy an enemy's vessels, but since navies have been built of iron and steel, the fire-raft is becoming obsolete.

Ragatz, rä'gäts, Switzerland, a fashionable Spa in the province of St. Gall on the Tamina, celebrated for its hot springs, mineral waters, and scenery. See PFEFFERS.

Ragged Robin. See LYCHNIS.

Ragged Schools, a name given in Great Britain to those institutions supported by voluntary contributions for the education of neglected children and the consequent prevention of juvenile crime. The idea of forming such schools was due to a Portsmouth cobbler, John Pounds, who about 1819 began to take in the ragged children of the district in which he lived and teach them while he was at work. This he continued till his death in 1839. The success of the plan caused a number of more influential persons to take the matter up, and in 1838 a ragged Sunday-school was opened in London. In 1841 the first feeding-school, in which the children are not only educated but kept and fed for the day, was started in Aberdeen. What gave a greater impetus than anything else to the ragged school scheme was Dr. Guthrie's 'Plea for Ragged Schools,' published in 1847. It had an immense circulation, and was followed by the extension of the system to every considerable town in the kingdom. The name ragged schools was first adopted in 1844. Owing to the education acts, and especially the introduction of compulsory school attendance and abolition of fees, many of these schools were absorbed by the school-boards, and altogether they may be said to be a thing of the past.

Raghuvarṇa, rä-g-hoo-vān'sha, one of the two epics of the Sanskrit poet Kālidāsa (q.v.). Its subject is the legendary history of the solar kings, or kings descended from the sun. See SANSKRIT LANGUAGE AND LITERATURE.

Ragie, a grain. See ELEUSINE.

Raglan, Fitzroy James Henry Somerset, LORD: b. 30 Sept. 1788; d. Sebastopol 28 June 1855. In 1804 he entered the army and in 1807 served on Wellington's staff in the expedition to Copenhagen, while throughout the Peninsular campaign he served as military secretary. In 1814 he acted for a short time as secretary to the embassy at Paris, and from January to March 1815 was minister plenipotentiary there. At Waterloo he lost his right arm. From 1819 to 1852 he was military secretary to the Duke of Wellington, in 1852 became master-general of the ordnance and in October of that year entered the House of Peers as Baron Raglan. He was commander of the English forces in the Crimean war, where he suffered much from the early failures of the campaign and from the hostile criticism of the inefficient commissariat arrangements. Consult Kinglake, 'Invasion of the Crimea.'

Ragman Rolls, documents containing a record of the acts of allegiance extorted by Edward I. of England from the nobility and gentry of Scotland in 1291-2 and 1296. The document was delivered back to the Scotch along with other records and muniments in 1329 in terms of the Peace of Northampton when the independence of Scotland was formally acknowledged. It is now deposited in the British Record Office.

Ragnarök, räg'na-rék', in Scandinavian mythology, the day of doom when the present world will be annihilated, to be reconstructed on an imperishable basis. The title of the concluding portion of Wagner's great operatic trilogy 'Götterdämmerung' is a translation of this word. In that work is depicted the downfall of Woden and the gods and the triumph of perfect human love. William Morris also treats this subject in his 'Sigurd the Volsung.' 'Ragnarök' is the title of a novel by Ignatius Donnelly.

Ragout, ra-goo', a French dish prepared of meat or fish stewed with vegetables, and highly seasoned.

Ragozin, rä-gō'zēn, **Zenāide Alexeievna**, Russian-American writer: b. Russia 1835. She traveled widely in Europe and in 1874 came to the United States. She is a member of the leading American and European literary societies, and has achieved a wide reputation as an author. Her most important books are: 'The Story of Chaldea' (1886); 'The Story of Assyria' (1887); 'The Story of Media, Babylon, and Persia' (1888); 'History of the World'; 'Siegfried, the Hero of the Netherlands' (1898); 'Roland, the Paladin of France' (1899); 'Salambo, the Maid of Carthage' (1899).

Rags, though valueless for most purposes, are yet of great importance in the arts, particularly in paper making. Woolen rags of a loose texture, and not too much worn, are unraveled by means of machinery, and mixed up with good wool, to form what is known as "shoddy," with which cheap woolen goods are made. Large quantities of rags are imported to the United States from Great Britain and the continent of Europe.

Ragueneau, räg-nō, **Paul**, French missionary and explorer: b. Paris 1605; d. there 3 Sept. 1680. He joined the Jesuit order, and went to

Canada in 1636 to work among the Indians, first visiting the Hurons. In 1640 he made an unsuccessful attempt to secure the release of French prisoners from the hostile Iroquois. Becoming the head of the Jesuit missions in Canada in 1650, he brought the remnant of the Hurons to Quebec to escape the Iroquois. On a visit to the Onondaga tribe of Iroquois he nearly lost his life. His chief success was with the Hurons, with whom he labored until 1666, when he returned to France and acted as agent for the Canadian missions. He wrote 'Vie de la Mère St. Augustine, religieuse Hospitalière de Quebec en la Nouvelle France' (1672); 'Relation de ce qui s'est passé de plus remarquables es Missions des Pères de la Compagnie en la Nouvelle France' (1647-57), the latter work covering the years 1645-52 and 1656-7. Consult: Parkman, 'The Jesuits of North America' (1867); 'The Jesuit Relations' (1896-1901).

Raguet, rä-gä', Condý, American political economist: b. Philadelphia, Pa., 28 Jan. 1784; d. there 22 March 1842. He was educated at the University of Pennsylvania, studied law, and later entered upon a commercial career. He went to Santo Domingo in 1804 as supercargo on a vessel and made a second voyage to that island in 1805. In 1806 he went into business on his own account and was eminently successful, amassing an immense fortune and playing an important part in the commercial affairs of the day. In 1812 he was active in providing for the defense of Philadelphia against the expected attack of the British fleet, and in 1815 was elected to the State legislature where he subsequently served in both houses. He was appointed United States consul at Rio Janeiro in 1822 and in 1825 became *chargé d'affaires* to Brazil, an office he occupied until 1827. After his return to the United States he edited several journals devoted to free-trade doctrines, among them 'The Free Trade Advocate' in 1829; 'Examiner' in 1834-5; 'The Financial Register' in 1837-9; he also published two small volumes relating to Santo Domingo; 'Principles of Free Trade' (1835); 'On Currency and Banking' (1839); etc.

Ragusa, rä-goo'sä (Slavic, DUBROVNIK), a seaport town of southern Dalmatia, Austria-Hungary, on a peninsula projecting into the Adriatic. It lies at the foot and on the slopes of Monte San Sergio and its streets rise in terraces from the Corso, the principal thoroughfare, which traverses the centre of the city. There are old walls flanked with towers and a fort erected during the French occupation in the beginning of the 19th century. Among the notable public buildings are the cathedral dating from the first years of the 18th century; the new Greek church; the older churches of the Franciscans, Dominicans, and Jesuits; the town-hall, anciently the governmental palace, completed in the early part of the 15th century after nearly a hundred years in building, and forming a magnificent example of the Gothic-Venetian style; and the Dogona, of the same architectural type. The industrial interests of the town comprise chiefly manufactures of silk, leather, and liqueurs. The coasting trade is important, but owing to the shallowness of the harbor, centres chiefly at Gravosa, some four miles to the north. The population in 1910 was 14,500. Ragusa was

founded in the 7th century of our era by refugees from the ancient Epidaurus, now known as Ragusa Vecchia, when that city, whose origin goes back to the 6th century before Christ, was destroyed by the Slavs. Ruled in turn by the Byzantines, the Venetians and the Hungarians, it acquired in the 13th and 14th centuries, through trade and unscrupulous diplomacy, lordship over a territory of some 750 square miles and maintained its existence as an aristocratic republic, paying tribute, after 1440, to the Turks. The prosperity of the town was undermined by several epidemics in the 16th century and by repeated earthquakes of which that of 1667 was the most disastrous. In 1806 Ragusa was occupied by the French, two years later the republican form of government was abolished, and in 1809, with the rest of Dalmatia, it was annexed to the Illyrian kingdom. In 1814 it passed to Austria. The see of Ragusa was founded in 980, and from 1121 to 1831 it was the seat of a Roman-Catholic archbishop. So well known were its trading vessels in former times that our word *argosy* is derived from the name of this port.

Ragusa, a town of Sicily, in the province of Syracuse, on the mountain stream Erminio, some 30 miles west-southwest of Syracuse. It has considerable manufactures of cotton and other textiles, oil, furniture, and asphalt and carries on an important trade in corn and wine. It comprises two communities, Ragusa proper with a population of about 32,000, and Ragusa Inferiore with 8,550 inhabitants. Ragusa is supposed to be the ancient Hybla Heræa.

Rag'wort, any of various composite weeds of the genus *Senecio*, now common in all parts of the world. These coarse, yellow-flowered, pubescent plants are allied to the thistles, and some of the score of American species are known as squaw-weed, ragwort, and butter-weed, and in England as groundsel. See *SENECIO*.

Rahi, räi, Karl, Austrian painter: b. Vienna 13 Aug. 1812; d. there 9 July 1865. At 19 he won a prize at the Vienna Academy and then started on his first tour among the art centres of Germany, Hungary, and Italy. He made his home in the last named country from 1836 to 1843, studying especially the painters of the Venetian and Roman school, from whom he derived the grandeur of conception and noble coloring for which his works are distinguished. In 1846, after two years' residence as a portrait painter in Vienna, he resumed his travels and practised his art with success and profit in Holstein, Paris, Rome, Copenhagen, and Munich. Among his historical paintings of his first period are 'The Finding of Manfred's Body'; 'Manfred's Entrance into Lucera'; 'The Catacombs during the Persecution' (in the Hamburg Gallery and a replica in the Berlin National Gallery). He was appointed professor in the Berlin Art Academy in 1850, but his political opinions were extreme and violent and he was compelled to leave the city. The private school which he thereupon opened became the most important seminary of painting in Austria. He meanwhile applied himself to much decorative work, as is testified by the painted façade and vestibule of the church in the Old Meat Market at Vienna, the four compositions from the Greek

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heroic age, and the 'Four Elements' in the palace of Baron Sina. In 1864 he painted in the Museum of Arms a series of allegorical figures of heroic size. To this period belong his fresco, 'A Maid from Foreign Lands'; and the designs for a ball-room in Oldenburg Castle and 'Incidents of the Argonautic Expedition.' His last works consisted of designs for the decoration of the New Opera House at Vienna. These were executed by his pupils after his death. He unites in his pictures the rich coloring of Rubens and Titian with a harmony of grouping monumental in its impressiveness. Yet his handling of form inclines to coarseness and exaggeration. Among the most eminent of his pupils were Bitterlich, Eisenmenger, Lotz, Griepenkert, Gaul, and Than. Consult: George-Mayer, 'Erinnerung von Karl Rahl' (1882).

Rāhu, rā'hoo, in Indian mythology, the demon who is imagined to be the cause of the eclipses of sun and moon. Rahu, having stolen of the nectar of immortality, was caught and beheaded before he swallowed the divine stuff. The head thus became immortal, and ever afterward followed the sun and moon. When it occasionally caught them an eclipse resulted.

Rahway, rā'wā, N. J., city, in Union County; on the Rahway River, and on the Pennsylvania railroad; about 20 miles southwest of New York city. It is a residential city, and its clean, well-laid-out streets, its parks, and fine residences make it an attractive suburb. It has considerable manufacturing interests; the chief establishments are chemical works, printing houses, shirt factories, lace curtain factories, felt mills, steel works, carriage and music box factories. There is a large trade in manufactured articles, fruit, and vegetables. It has a high school, public and parish schools and a library, which has about 20,000 volumes. Pop. (1910) 9,337.

Rai Bareli, rī bā-rā'le, India, (1) headquarters of a district of the same name, on the banks of the Sai, 48 miles southeast of Lucknow. It has a spacious fort, a magnificent palace, four fine mosques, and the tomb of Nawab Jahan Khān. Pop. 18,798. (2) The district of Rai Bareli forms a part of the Lucknow division, and has an area of 1,751 square miles. Pop. about 1,100,000.

Raiatea, rī-ā-tā'ā, Polynesia, an island of the Society group, northwest of Tahiti; area, 75 square miles. It is mountainous (3,400 feet), but fertile, and traversed by many streams. The chief products are cotton and copra. Pop. (Protestant) 2,300.

Raibolini, rī-bō-lē'nē, **Francesco**. See **FRANCIA, FRANCESCO**.

Raiffeisen, rīf'i-zēn, **Friedrich Wilhelm**, German economist: b. Hamm, near Coblenz, Germany, 30 March 1818; d. 11 March 1888. He entered the army in 1835, but was compelled by ill health to withdraw and then entered the civil service. During the agricultural troubles of 1846-7 he perceived the difficulty with which the small landholder procured credit and he conceived the idea of establishing small mutual credit associations which freed the farmer from the exorbitant rates of the usurers. His first efforts were at Heddersdorf and Wyr-

busch and he then proceeded to extend the operation of the plan throughout Germany. In 1866 he broke down from overwork and retired for a time from public service. In 1878 he founded the 'Landwirtschaftliches Genossenschaftsblatt' at Neuwied. He lived to see his plan in successful operation in Germany, Austria, Switzerland, and Italy. He wrote: 'Instruktion zur Geschäfts- und Buchführung der Darlehnskassenvereine' (1869); 'Kurze Anleitung zur Gründung von Darlehnskassenvereinen' (1888); etc.

Raikes, rāks, **Robert**, English founder of Sunday schools: b. Gloucester, England, 14 Sept. 1735; d. there 5 April 1811. He succeeded to his father's business as editor and publisher of the Gloucester 'Journal' in 1757 and used its influence in exposing certain prison abuses in his native town. In 1781 he founded several Sunday schools which he engaged needy women to teach at a shilling a day, and succeeded in inducing the attendance of the children of the city. In 1803, largely through his efforts, the Sunday School Union was founded. Consult: Lives by Gregory (1877), and Eastman (1880); Harris, 'Robert Raikes: The Man and his Work' (1899). See **SUNDAY SCHOOLS**.

Rail Sections as Engineering Structures and Their Correlations to Equipment and Operation of Railroads. It is what a rail section can do, its combined stability, efficiency, and capacity with the equipment for carrying the loads, which determine its status and relative importance as an engineering structure. A rail section is heavy at the present time, of which sufficient for a mile of track equals or weighs more than the passing locomotive.

The installation of the railroads in the United States from 1826 to 1833 was usually with strap-iron rails, forming the bearing surface for the wheel treads, and guide to the flanges, laid on wooden or stone stringers as the girders.

The engines were of the four-wheel type, short wheel bases, and rode unsteadily over the light tracks. The driving-wheel loads, at first intended not to exceed 1,700 pounds, when increased to 4,000 pounds injured the light structures, at speeds of 10 to 15 miles per hour.

John B. Jervis, chief engineer of the Delaware & Hudson Canal Company's railroad, completed in 1829 the superstructure of strap-iron rails on wooden stringers, designed for the transportation of coal by steam-engines, from the mines to the canal at Honesdale, Pa.

Three engines were constructed in England, under directions not to exceed 1½ gross tons per wheel, but were heavier as built. The "Stourbridge Lion," 8 Aug. 1829, made only a short trial trip, and proved too heavy for the structure, and locomotives as motive power were abandoned.

The track proved adequate for the transportation of about 1,000,000 tons of coal annually, for several years, under the designed static wheel loads.

Mr. Jervis was the chief engineer of the Mohawk and Hudson Railroad in 1830, and 9 Aug. 1831 made the successful trial trip with the locomotive De Witt Clinton and passenger train. The superstructure was strap-iron rails 2½ inches wide, 9/16 of an inch thick, the upper corners rounded to a width of 1½ inches, and

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laid central upon 6 x 6-inch pine stringers, supported by stone blocks, each of two cubic feet, spaced three-feet centres, and set upon broken stone foundations, for inflexible supports as for buildings. This theory Jervis discarded in 1832 for that of the elastic roadbed.

The De Witt Clinton weighed 6,758½ pounds, and the John Bull, made by Robert Stephenson & Company, Newcastle-on-Tyne, England, weighed 12,742 pounds, of which 8,745 pounds were upon the pair of driving-wheels, which proved heavy for the superstructure and rode unsteadily over the track, and seldom used as received.

Mr. Jervis, in 1832, designed his four-wheel "leading and guiding truck," and substituted it for the front pair of carrying wheels of the engine, which extended the wheel-base and gave it lateral and vertical flexibility for ease of locomotion.

The truck, supporting the front of the engine, and the one pair of drivers the rear, subdivided the total load for distribution, and used a part to stiffen and strengthen the track for the driving-wheel loads, which was the inception of this valuable principle of American practice. A second pair of drivers was added, for greater adhesion, making the type of the American locomotive, which could now cross the mountain divides without inclined planes, a requirement for railroad extension and operation.

The prototype of the present tee sections, to be rolled as one piece and spiked directly to the wooden cross-ties or stone blocks, was designed by Robert L. Stevens in 1830, and laid on the Camden & Amboy Railroad in 1832. It was rolled in Wales, in 16-feet lengths, fished by 6-inch riveted two-hole plates, was 3½ inches high, ¾ inches base, head 2½ inches wide, and weighed 39 9/16 pounds per yard; therefore was expensive, and the principles of construction not copied generally until after 1840, when it had demonstrated its value.

The two problems, evolution of the locomotive and of the rail section, were being solved at the same time, an improvement in either aiding the other, owing to the correlations which exist between them.

The strap-iron rails served to develop practical locomotion only, as about 4,000 pounds static driving-wheel loads were their limit, the spikes drawing or breaking, and failed to hold the iron to the wooden or stone stringers, as mechanical structures, and frequently the facing ends of the rails ("snake heads") sprang up above the centre of the following wheel and curled through the floor of the car, impaling passengers in their seats.

Sundry types of sections for iron rails, including Birkinshaw's "fish-bellied," and the Clarence pattern, set in chairs, compound forms of two or three pieces, were tried with the strap-iron rails, and by or before 1844 the most efficient iron tee sections became the principal reliance for service until 1863, the advent of Bessemer steel.

The compound rails failed mechanically after a short use. The best quality of iron rails, in light sections, rendered some years of service, until the static driving-wheel loads began to exceed 7,000 pounds. Before they had reached 10,000 pounds, lamination and exfoliation of the iron in the bearing surface were rapid, owing

to its limited and inadequate physical properties of cubic elasticity.

The pile of iron for the rail was formed of several slabs or pieces, put into a furnace and brought up to a welding heat, with the expectation that complete union would occur between all of the pieces in rolling. This did not take place, and the cinder which was in each bar rolled out more as a bundle of fibres in the section, preventing the formation of a solid homogeneous structure. The linear elasticity was sufficient as a girder, but deficient in cubic elasticity for the metal in the bearing surface.

The manufacture and use of heavier and stiffer sections of iron, for smoother and more stable tracks, caused such rapid wear of the rails that many companies returned to the use of lighter sections. This was a check to the extension and development of transportation for the country.

The introduction, in 1863, of light rails of Bessemer steel, a product more homogeneous and solid than iron, furnished a metal which, in the bearing surface, wore well, exceeding the life of 10 to 15 iron rails. This in a few years reduced operating expenses and enabled the extension of railway systems to new territory.

The cost of the steel limited the rails to light and limber sections. They were inefficient as engineering structures, and did not permit the desired enlargement of the locomotives to overcome the resistance of heavier trains, and meet the demands and requirements of transportation.

The maximum static load per driving-wheel in 1876 was about 13,000 pounds for some of the largest passenger engines, but three times greater than it was upon the strap-iron rails.

I invented and constructed my Dynagraph in 1874, to measure train resistance, and observed upon the Lake Shore & Michigan Southern, Baltimore & Ohio, Philadelphia, Wilmington & Baltimore, Boston & Albany, and the New York Central & Hudson River railroads that on new rails well surfaced the resistance was less than upon worn rails with low joints, the topographical conditions being the same.

A test was made of a passenger train, in 1878, on the New York Central & Hudson River Railroad, of 9 cars, 300 tons weight, at 51 to 52 miles per hour; the resistance was 11½ to 12 pounds per ton, only two thirds of that estimated by the English formula of Clarke. These were valuable facts to establish, not only as to the amount of the train resistance, but to one of its elements, for on the smoother track the resistance for every wheel was reduced, by rolling forward with less vertical undulations and shocks.

A sphere moving over a perfect plane in a straight line, irrespective of speed, theoretically would not do work for or against gravity, applies in principle to a moving car-body or wheels on the rails. Tracks of true planes on steam railroads are not expected to be realized, yet it was necessary to investigate their condition and measure the undulations on the light steel rails, to ascertain what was required to add to their efficiency and commercial value as engineering structures. The investigations of the condition of the track were made by the complete instruments I designed in 1880 for my Track Indicator. A special 6-wheel truck, of 11-foot wheel base, was made, to carry one end

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of the 50-foot car which contains the recording mechanism. The total load upon the truck is 19 tons, and the outer wheels act as the datum plane, while the middle wheels indicate the surface undulations of each line of rails, upon the moving band of paper, on a scale of one inch per 50 feet of track which is sufficient to show the detail of each rail. The vertical scale is full size.

The theory is, that if the running surface of the rail in its general depression under the truck is smooth, the recording pen would draw a straight line; if not, its deviation.

The gauge of track, speed, and distance, are measured, while the sections, mile posts, and stations, are located as they are passed.

The undulations are summed up automatically into feet and inches per mile, which furnish the data for the condensed diagrams, and show on a scale of $\frac{1}{4}$ of an inch per mile the comparative condition of the track. These were commenced in 1881, and annually repeated exhibit the reduction in undulations, by the transition from the light and limber sections to the heavier and stiffer rails, as engineering structures, and also that the static driving wheel loads have nearly doubled in the meantime.

Paint is ejected automatically on the rails, for the trackmen, where the deflections exceed $\frac{1}{8}$ of an inch.

The inspections of the track on the early steel sections indicated that the rails on all the different railroads had characteristic permanent sets, which proved that the mechanical elements of stiffness of the 4 or 4 $\frac{1}{2}$ -inch sections were insufficient for the wheel loads. The trackmen were unable to maintain the track and prevent sets taking place in the rails, and rapid cutting of the cross-ties under the rail seats. The joints were low, the facing ends of the rails cut out, which gave shocks to every passing wheel, while the undulations under the wheel loads of the Track Indicator recorded from 6 to 12 feet per mile.

The original and condensed diagrams of over 10,000 miles of track were measurements and new data, to study the action and requirements of a section in the track, and in 1883 I designed the pioneer 5-inch 80-pound steel rail, for the New York Central & Hudson River Railroad, and in 1884 commenced to replace their $4\frac{1}{2}$ -inch 65-pound rails. With 15 pounds or only 23 per cent more of metal, the section was increased in stiffness 60 per cent and in strength 40 per cent, and with a head $2\frac{11}{16}$ inches in width enforced the resultant of the passing wheel loads by their treads to hold the rails in a vertical position on the cross-ties, checking the rolling out and spreading of the gauge, which augmented the running stability of the equipment.

The 80-pound rails made a stiffer, stronger and smoother track than the former 65-pound and were soon followed by the Pennsylvania and the other railroad companies' adoption of 5-inch 80-pound or heavier sections.

The augmented 60 per cent in stiffness and 40 per cent in strength, with the advantageous correlations existing between them and the equipment, enabled nearly doubling the axle and total loads of the locomotive and cars on the same roadbed. It marks a distinct epoch in the progress of transportation.

Mr. William Buchanan, general superintendent of motive power, New York Central & Hudson River Railroad, designed his famous locomotive, No. 870, in 1889, with 40,000 pounds upon the engine truck, 80,000 pounds upon two pair of driving wheel axles, and 80,000 pounds upon the tender when loaded with coal and water, which made the first 100-ton locomotive. These weights did not disturb the track on the stiffer rails as the lighter axle loads had upon the former limber rails. On November 30, 1891, the Empire State Express was installed, the fastest long distance train ever attempted, which still maintains its prestige, as a demonstration and educator of practical fast speeds on stable track.

The running time from New York to Buffalo, 440 miles, was 8 $\frac{1}{2}$ hours, including 3 stops, 2 changes of locomotives, and 28 slow downs. In 1895 the schedule time was reduced 15 minutes. The achievement was of interest to the railroad world as an accomplishment of what had been considered previously impossible. The practical effect of the stiff rails has been the construction of larger and more powerful locomotives and an increase of speed on railroads, as shown by statistics. The Twentieth Century Limited, on the New York Central & Hudson River Railroad, and the Pennsylvania Special on the Pennsylvania Railroad, are now running from New York to Chicago and return each way in 18 hours.

The mechanical properties of stiffness and strength of a section are secured in the design for a given height and weight of metal by distributing as much of it in the head and base as far from the neutral axis for the longitudinal stresses as requisite for the relations of the bearing surface, guide and girder, denoted in Fig. 2.

The mechanical properties of different sections, are ascertained and compared by their respective moments of inertia and moments of resistance, and in the higher and heavier sections they increase in a faster ratio than the weight, and cost,—an engineering and economic advantage. See Table No. 1.

The different weights of the sections have from 40 to 45 per cent of the metal in the

TABLE NO. I.

Weight of Section in lbs.	Height in inches.	Width of Head inches	Moment of Inertia 4th Power inches	Moment of Resistance cubic inches	Bending Moments carried per Section for 20,000 lbs. Unit Fiber Strains inch-pounds.
60	4.0	2 1-4	12.0	6.7	134,000
65	4.5	2 3-8	16.0	7.8	156,000
80	5.0	2 11-16	26.0	10.5	210,000
80	5 1-8	2 21-32	28.5	11.4	228,000
100	6.0	3.0	48.5	16.6	332,000

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head, 37 to 40 in the base, and 20 to 23 in the web. The bearing surface is crowned with a radii of 12 or 14 inches, while the upper corner radii are $\frac{5}{16}$ or $\frac{3}{8}$ of an inch. The fishing angles of the head and base are 13 or 14 degrees, according to the design—the latter being the best to take up the wear of the splice bars. The web is joined to the head, in the best designs, by fillets of $\frac{1}{2}$ inch radii.

The increased mechanical element of stiffness of rails lessens the deflections for a given load, while the strength reduces the unit fibre strains, therefore augments the capacity for larger bending moments and better distribution of the wheel effects to the cross-ties and ballast; but the wheel contact pressure intensity per square inch in the bearing surface is increased.

Standard sections of given weights, varying by increments of 5 pounds per yard, have been designed, with definite mechanical properties, and are manufactured as commercial products. My standards consist of 15 sections of 50 to 105 pounds per yard. There are three duplicate weights, but of different mechanical properties.

The 80- and 100-pound for main lines are in most general use, and the 65, 70, and 75 for branch lines, though the 80-pound will soon be a requisite. The New York Central & Hudson River Railroad commenced to lay my 6-inch 100-pound section in 1892, and that weight has become the standard for the Eastern trunk lines.

The A. S. C. E. standards are from 20 to 100 pounds per yard. The English standards for flat-bottom sections are of the same weights, for use in India.

"Bull Head" sections are standards for England.

The superstructure of the track, for American, English, French, and German steam railroads, is flexible, on an elastic roadbed as the foundation, and under the area of the wheel bases of the locomotives and cars to be loaded as uniformly as possible, by pressures which can be sustained.

and their generated forces, until the total resistance equals their effects.

The ballast and roadbed are compressed from one fifth to one third of the total amount of the temporary subsidence of the rail, and the latter is affected for a depth of 12 to 20 feet, according to its material, construction, and stability.

The rails are loaded only by the rolling wheel contacts, which bend them downward under the wheels, as indicated in Fig. 1—the positive bending moment—while in the wheel-spacing the flexure is upward—the negative bending moment; shearing stresses connecting the bending moments at the points of flexure.

The rail section therefore resolves and distributes its wheel-load effects by longitudinal components of stress, and produces compression in the metal above the neutral surface directly under the wheels, and below tension. Either side of the wheels in the spacing the stresses are reversed at the points of flexure, the wheel-space controlling the span of the bending rail more than that of the cross-ties. See *Stremmatograph Test No. 257*.

The strain in the metal of the rails is continuous for the entire wheel base of the locomotive, and not discontinuous per wheel. Comparisons for precision of the stresses under locomotives of the same or different types must include the total effects from all of the wheels as though distributed from their centres of gravity. See *Test No. 257*.

The tests of the unit fibre strains upon the same track show that reducing the wheel-spacing decreases the total bending moments, and distributes the load more favorably upon the foundation. This is confirmed in practice by the excellent results by the Ten-wheel, Pacific, and Consolidation types of engines.

Three Essential Principles of the Rail Section as an Engineering Structure.—First: The top as the bearing surface for the rolling wheel contacts.

Second: The side of the head, as the guide for the wheel flanges.

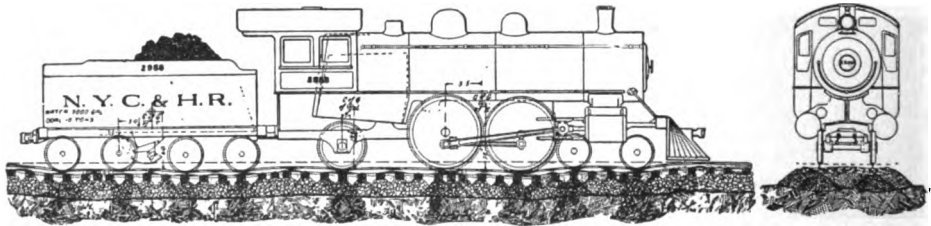


FIG. 1.—The broken line indicates the "Trackmen's Surface," while the surface of the rail under the driving wheels, the *Constrained Beam* in the General Depression. The cross-ties, ballast, and sub-grade are depressed decidedly under the specific deflections of the rails by the wheel contacts.

The positive bending moments under the wheels, and the negative constraining bending moments in the wheel spacing, with their respective fiber-strains, are indicated in the rails. The centers of gravity of the engine, locomotive, and tender are marked by a dot in their respective positions. Vertical scale of the General Depression is 24 times that of the locomotive.

The stiff rail section is the most conservative and useful member of the superstructure for this purpose, and advantage is taken of this fact in the construction of the American equipment, by distributing the total load on several wheels. The rails, cross-ties, and ballast, as illustrated by Fig. 1, are depressed from the trackmen's surface—represented by the broken line— $\frac{1}{8}$ to $\frac{3}{8}$ of an inch, to the loaded running surface in the general depression, by the wheel loads

Third: The entire section as a girder, to distribute the wheel-loads.

These are designated as bearing surface, guide, and girder, and illustrated by Fig. 2.

These three principles, embodied in a solid section, apply to limber or stiff rails, though the mechanical properties, as vertical stiffness and strength, will increase as the height and weight are augmented. See *Table No. 1*.

The numerous types of rail sections which

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have been designed, used, and sustained the service, since the installation of the railroads, are those only in which the bearing surface, guide, and girder have been fabricated in a solid piece.

The strap-iron rails on wooden or stone stringers, the compound rails of two or three pieces fastened together by rivets or bolts, all failed as engineering structures, from mechanical and metallurgical inefficiency, after short service, as the wheel-loads increased.

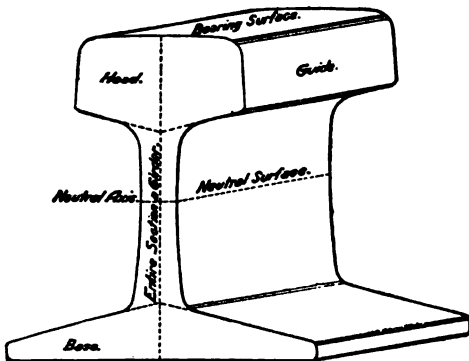


FIG. 2.—The Rail Section as an Engineering Structure of One Piece of Metal.

Physical Properties.—Sections of iron or steel have values as engineering structures according to their physical properties. The metal for the rail as the bearing surface, guide, and girder has therefore three requisite, dissimilar, but not inconsistent, functions to unite and serve by its physical properties.

First: The metal of the bearing surface under the rolling wheel contacts, in distributing its loads, resists deformation, shear and wear, principally by its mass hardness and cubic elasticity, and requires homogeneity, solidity, and malleability.

Second: The metal of the side of the head, as the guide for the passing wheel flange, resists abrasion best by its cell hardness and tenacity.

Third: The metal as the girder to distribute the wheel-loads, should provide for the bending moments, and consequent unit fibre strains, by less than one half of its elastic limits of linear elasticity.

The utility and durability of a rail section depend, therefore, upon the mechanical properties of its design, in combination with the physical properties of the material out of which it is fabricated.

Bearing Surface.—The functions of the section as a girder, for safety in distributing the wheel-loads, control the physical properties of the metal which may be provided for the bearing surface and guide. See Fig. 2.

The head of the rail must have sufficient width to form the bearing surface, to enable the metal, by its mass hardness, to receive and sustain the wheel-loads without rapid wear or decided permanent set as they roll over the rail. The metal in both the wheel and the bearing surface of the rail resists the intensity of pressure per square inch by its cubic elasticity, and to be efficient requires homogeneous solid metal.

The rails from the upper parts of the ingots often have an exterior layer of metal of normal chemical composition, but, owing to liquation in the fluid metal of the ingot, encloses a core of harder, more fusible steel, containing occluded gases affecting the homogeneity and solidity of the rail-head.

Such steel cannot sustain the heavy contact pressures of 100,000 pounds to 200,000 pounds or more per square inch, without flow or distortion, as its limits of cubic elasticity are reduced by the unsound metal.

Slight porosity in the steel, from entangled gas in the columnar structure one eighth of an inch under the bearing surface, develops into a defect under the traffic and a small piece becomes loosened and flakes from the inside upper corner. If the metal of the head of the rail is of coarse texture and unsound, it crushes for one eighth to one fourth of an inch under the wheel treads, and rapidly wears. See Figs. 8, 9, and 10.

Beneath the rolling wheel contacts the pressures are distributed both to the rail as the bearing surface and girder, by an area of steel from one tenth to one half of a square inch, which resists flow by support of the contiguous metal around and under the point of contact. While there is a slight compression of the metal, owing to its elasticity, it does not take a decided permanent set if solid, except by slight flow upon the extreme contour of the contact, to conform by its malleability to the average rolling wheel tread.

Stremmatograph tests on different sections show that, as the stiffness increases, the unit fibre stresses decrease, though the bending moments carried to make a smooth running track are augmented. This amplifies the wheel contact pressure intensity per square inch, imposing more work upon the metal in the bearing surface from the mechanical relations it sustains as part of the rail section in the more efficient girder or engineering structure. The quantity of metal in the bearing surface is limited in width of head, and reliance for effective service must be upon sound metal of good physical properties.

The axle loads, speed, and expended tractive effort produce two, three, or more times the burden by the passing wheels on the bearing surface of the present stiff rails than was borne by the former limber sections.

The bending moments carried by the light rails were only from 150,000 to 200,000 inch-pounds under the heaviest driving-wheel loads of the locomotives. On the $5\frac{1}{4}$ -inch 80-pound rails, under the present wheel-loads, they are from 250,000 to 400,000 inch-pounds, while on the stiff 6-inch rails they may be from 400,000 to 500,000 inch-pounds. See Table No. 1.

The physical properties of the best early steel rails were usually adequate for their conditions of service.

The metal in the section was of fine texture, solid, homogeneous, and in the bearing surface had malleability when its limits of cubic elasticity were surpassed, and ductility as a girder when its limits of linear elasticity were exceeded.

It is understood that, with the increase of the stiffness and strength of the section, the unit fibre strains would be decreased in the heavy and stiff rails.

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It is not known that, due to the looseness of the rails on the cross-ties, the latter in the ballast, and the depression of the roadbed to carry the wheel-loads, the bending moments augment with the stiffness of the rails. This reduces slightly the area of contact between the rail-head and the wheel-tread, and increases the intensity of the pressure per square inch, which has, and can be sustained by metal of sufficient physical properties.

The Guide. The Side of the Head for the Passing Wheel Flanges.—A track of which the alignment is nearly all tangent, the functions of the metal exercised principally will be in the bearing surface, and for the entire section as a girder to sustain, guide, and distribute the wheel-loads.

The fillet, in the throat of the flange of the wheels, by practically a rolling contact with the upper corner of the head, becomes sufficient to guide the passing trains without undue abrasion.

The three functions of the metal are required on curves, especially with combined gradients, to guide and change the direction of the trains, by the passing wheel flanges, which, by the pressure required, produces severe cutting abrasion on the inside rail-head, and on the opposite rail wear and flow of metal in the bearing surface by the wheel treads.

The loss of metal on the side of the head of the rail, as the "guide," by abrasion from the wheel flanges, is 3 to 10 times more rapid than from the same wheel treads in the bearing surface.

Rails of a quality of metal which on tangents will wear 6 to 10 years, on curves combined with heavy gradients may become flange-worn in 12 to 18 months.

Rails require width of head, tough, tenacious metal of fine texture, and hard as permissible, for the girder, to withstand long the abrasion of the wheel flanges.

The Entire Section as a Girder and Engineering Structure.—Provision for the mechanical properties of the section is made in the design, while as a metallurgical product the requisite physical qualities must be secured by the chemical composition, heat treatment, and method of manufacture, a series of difficult problems.

Safety is the first consideration, and the physical qualities must be confined to those for the bearing surface, guide, and girder, which will withstand the service of the rail in the track without fragility in the cold weather, which would render them unsafe.

The rail section as the girder, distributing its wheel-loads by longitudinal components of stress, must be made of a metal which permits, by its elasticity, the necessary flexures of the rails to carry the moving trains. The unit fibre strains in the limber steel rails were high, for those with elastic limits of only 30,000 to 35,000 pounds were limited to .001 of an inch extension per inch, before acquiring sets in service. Those in which the elastic limits were from 45,000 to 56,000 pounds only were capable of sustaining the unit fibre strains of the bending moments due to the wheel effects, without taking sets in the track.

Unit fibre stresses of 25,000 to 35,000 pounds under high-speed trains are to be expected in the rails, for they must sustain the wheel-loads

of the locomotives, the dynamic effects due to speed, and those due to the expended tractive effort.

The maximum unit fibre stresses in rails under daily trains are often two and three times higher than is considered permissible for bridge members. In rails, a stress under the wheels of either compression or tension lasts but a fraction of a second before reversal, while in bridge members a stress may continue for several seconds.

The sound metal in the heavy and stiff sections, which is enduring the service, has elastic limits of 55,000 to 60,000 pounds—nearly equal to the ultimate strength of the steel used for bridge members—and in addition has an elongation of 15 to 20 per cent in two-inch specimens.

The Barrow or other brands of early limber steel rails, in which the elastic limits ranged from 53,000 to 56,000 pounds per square inch, proved sufficient for the bearing surface, the guide, and the girder, for their limited mechanical properties and wheel-loads. The actions of the limber sections as engineering structures in the track are illustrated in Figs. Nos. 3 and 4, by a reproduction of a portion of one of the original diagrams by the Track Indicator, of the surface undulations of 10 rails. In Fig. 3 the joints are worn and low, and gave shocks to each passing wheel. The rails did not form a continuous girder for the strains in the general depression. The undulations as measured were 12 feet per mile.

Fig. 4 is from 10 new rails, poorly finished at the mills, and the cross-ties cut in the rail seats. Undulations, 8 feet per mile.

Fig. 5 is from 10 stiff 6-inch 100-pound rails upon the same roadbed as No. 4, the joints not being indicated; the undulations, 1 foot 9 inches to 2 feet per mile.

The stiff 5½-inch 80-pound rails do not show the joints until after years of service. Undulations, 2 feet and 9 inches per mile.

Figs. 6 to 11, inclusive, are photomicrographs of the structure of steel rails, each magnified 50 diameters.

Fig. 6 is from a Barrow rail 1868, and nearly all of the early steel rails had a similar structure. It is of fine texture, and has high limits of cubic elasticity. The steel was 0.40 in carbon and rolled from hammered ingots and blooms at a low temperature. The output was less than 200 tons per day and sold for \$120 in gold per ton.

The steel for the heavy sections should be of fine texture, sound, homogeneous, and tough, though more difficult to secure than in light sections.

The chemical composition, according to the weight of the section, ranges as follows: Carbon 0.50 to 0.65, manganese 0.90 to 1.20, silicon 0.10 to 0.20, phosphorus and sulphur, each not to exceed 0.07. In ores containing 0.10 in phosphorus, the carbon is reduced 10 to 15 points.

The ingots are bloomed in trains and rolled direct into rails at some mills, and in others the blooms are reheated for final rolling.

The structure for the finished rails is granular and often too coarse for durable service in the bearing surface and guide, and fragile as the girder.

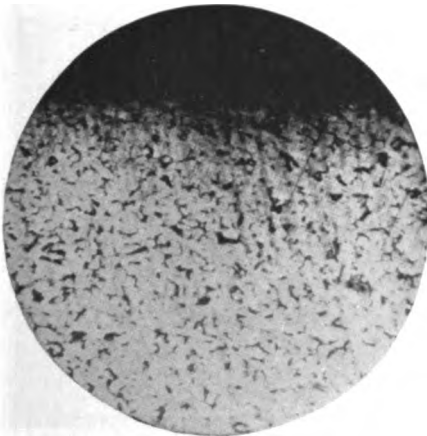


FIG. 6.—BARROW STEEL, 1868.
NON-GRANULAR.

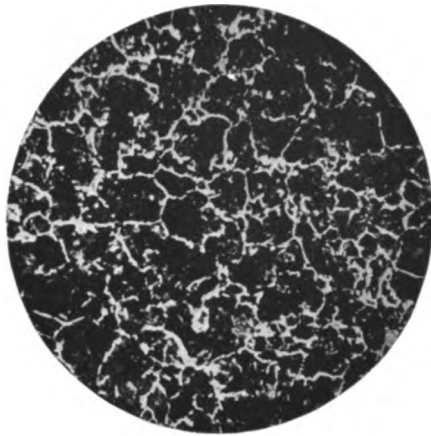


FIG. 7.—100-LB. STEEL, 1892.
GRANULAR. GOOD.

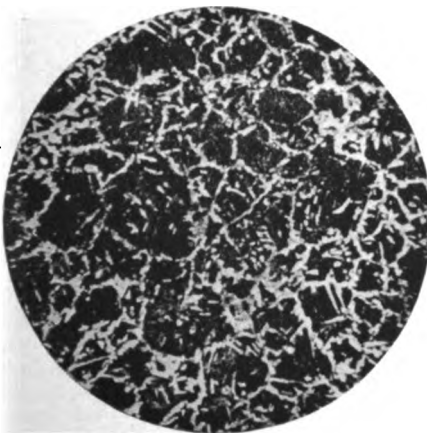


FIG. 8.—80-LB. STEEL. COARSE.
GRANULAR, 1902.

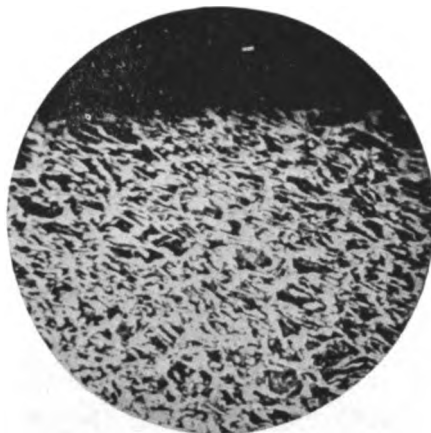


FIG. 9.—SAME STEEL AS NO. 8.
CRUSHED IN THE BEARING SURFACE.

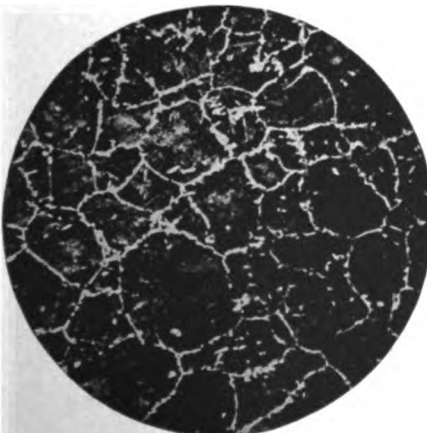


FIG. 10.—100-LB. STEEL.
COARSE GRANULAR, 1900.

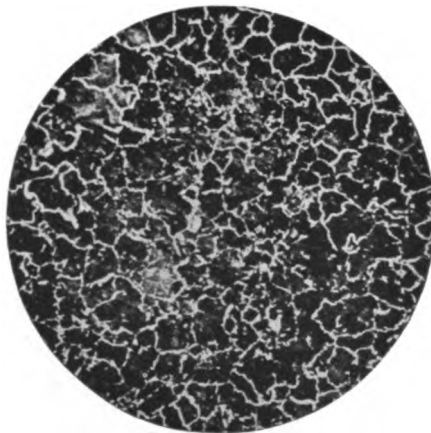


FIG. 11.—80-LB. STEEL. GRANULAR.
GOOD, 1902.

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Attention is given to the rolling and finishing temperatures, to improve the structure.

Fig. 7 shows the structure of the first 6-inch 100-pound rails rolled 0.60 in carbon, and has rendered excellent service under the heavy wheel-loads.

Fig. 8 is from an 80-pound rail, 0.45 carbon

ported joints, has not been excelled for long, efficient service.

The number of cross-ties, 7 x 9 inches, 8 feet or 8 feet 6 inches long, range from 16, 18, to 20 per 33-foot rail. The ballast is of gravel or broken stone, 8 to 12 inches in depth, under the cross-ties in the main line tracks.

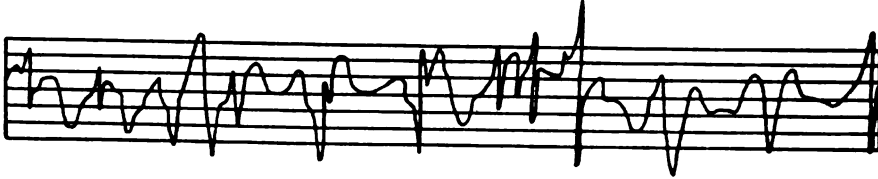


FIG. 3.—Surface undulations 4½ inch 65 lb. rails 1881. Joints low and worn.

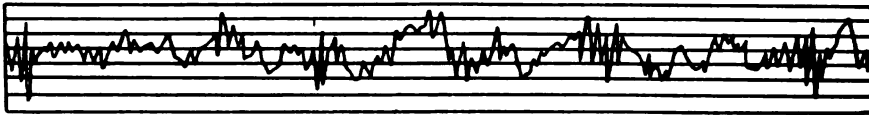


FIG. 4.—Surface undulations, 4½ inch 65 lb. new rails 1888. Wavy finish and cross-ties cut in rail seats.

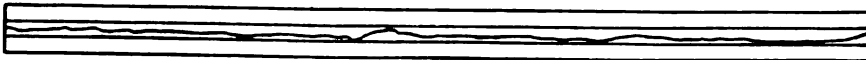


FIG. 5.—Surface undulations 6 inch 100 lb. rails 1892. Joints do not show their location.

and 0.10 in phosphorus—coarse, granular, and contains occluded gases.

Fig. 9, from the same rail, shows the structure as crushed for one fourth of an inch in depth in the bearing surface.

Fig. 10 is from a 100-pound rail of about the same chemical composition as No. 8, and crushed as a frog point after three months' service. The coarse structure has low limits of cubic elasticity and is fragile.

Fig. 11 is from an 80-pound rail which is rendering good service. The coarse structure of Figs. 8 to 10, inclusive, was due to the excessive heating and high phosphorus.

Rails in large sections have and can be made, by proper care in manufacture, which will be durable.

The 6-inch 100-pound rails of elastic limits of 60,000 pounds per square inch, laid on the "In-bound Main" at Grand Central Station, New York, in 1895, have carried over 300,000,000 tons, with only a loss in height of 3/32 of an inch in the bearing surface, exceeding the service of any light sections.

Rails at the mills are manufactured in two standards of length, 30 and 33 feet, with 10 per cent of shorts. They are laid in the track with either alternate or opposite joints, the former being general in America and the latter on the Continent. The joints may be suspended or supported, the former being common, though the latter prove to be the more efficient for long service, in making the rails a uniform, continuous girder under the passing trains. The types of joints as commercial products are numerous. The plain angle bar, with a thin web which can be punched out of steel of 55,000 to 60,000 pounds elastic limits, when in 36- or 40-inch lengths with 6 bolts, forming three-tie sup-

The periods of time which indicate the correlations between the sections as engineering structures and the driving-wheel loads, show that they have doubled practically on the stiff steel sections in the last 15 years.

The railroad companies have been quick to take advantage of such realities, by replacing their limber by 80-, 90-, and 100-pound stiff rails as the only and most economic method by which earnings could be saved, from an average freight rate of less than 1 cent per mile.

TABLE NO. 2. DRIVING-WHEEL LOADS IN RELATION TO SECTIONS OF RAILS.

Section	Date	Pounds per wheel
Strap iron.....	1826 to 1833	1,700 to 4,000
Iron tee.....	1833 to 1863	7,000 to 10,000
Light steel.....	1863 to 1890	10,000 to 13,000
Heavy and stiff steel.....	1890 to 1905	20,000 to 25,000

I was able to estimate and state the reduced undulations the stiff rails would record under my Track Indicator before they were rolled in 1883. They denoted higher standards than had been previously attained, and seemed improbable to officials.

The computed results for the Boston & Albany Railroad, with its curvature and heavy gradients, were, that the condition of track would be indicated between the 15th and 16th lines on the condensed diagrams.

The company commenced to lay their 95-pound rail in 1891, completed the line in 1897, and the average sum of the undulations per rail per mile, for the track inspection, was 15.42 lines on the condensed diagrams. I made the rails of 0.60 to 0.65 in carbon, the phosphorus not exceeding 0.06, and they were smoothly finished at the mills, to achieve definite effects.

The practical results since the transition from the limber to the stiff sections show that it has

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been imperative to introduce them, to carry the greater wheel-loads and check the rapid destruction of the cross-ties, which cost twice as much as the rails. The railroads have been enabled, without any other attention to the roadbed, to double practically the capacity of their tracks, by the increase of 60 to 100 per cent in the stiffness of their rails.

The important purpose in the construction of the superstructure of the track is to reduce and distribute the wheel-loads to such pressures, as the cross-ties and roadbed can sustain several thousand repetitions without decided permanent change, and the transition from the limber to the stiff rails has shown that this is the quickest engineering construction to load the foundation, for increased capacity.

Another method of distributing the loads and reducing their intensities to the ballast is by close wheel-spacing of the locomotives and cars—a feature of American practice.

The cross-ties under the limber sections were cut out in the rail seats by the intense pressures, while the ballast was overloaded to sustain 3,000 to 4,000 pounds per square foot. The stiff rails check the mechanical abrasion of the cross-ties, which can now be treated, and by that process add many years to their service.

The stiff and strong sections have enforced replacing the iron and steel bridges with those capable of carrying as heavy equipment as the rails.

The enlargement of the passenger locomotives—which had not been possible on the limber steel sections, owing to their weakness as girders—made rapid progress on the stiff rails, and in the Atlantic types now (1905) weigh 145 tons, while in the Pacific types 161 tons.

Equally useful to the railroads and community, beside the fast trains, has been the possibility of increasing the weight of the passenger, express, and mail trains to 500 or 600 tons, and run them upon schedules but little slower than those at high speeds and limited weight, the resistance being, on stiff rails at 55 miles, per hour about 11 and 10 pounds, respectively.

Freight locomotives of four, five, and in one type six, pairs of driving wheels, weight from 150 to 175 tons, are not severe on the tracks of stiff rails, when distributing their load and expended tractive effort under so many drivers. Freight trains of 2,000, 3,000, and 4,000 tons are in daily operation, compared to those of 500 or 600 tons on the limber rails.

The resistance of heavy trains is less per ton than those of smaller units. Freight cars of 60,000, 80,000, or 100,000 pounds capacity, with a spacing not exceeding 18 or 20 feet between the inside wheels of the trucks, make the general depression of the track continuous from the front pilot wheel to the rear wheel of the train. The foundation is loaded more favorably, and the train resistance decreased.

The greater capacity of freight cars has reduced the freight-train mileage, effecting an economy. In 1893 the freight-ton miles in the United States were 93,588,111.833, and the freight-train miles 508,719.506. In 1903 it was 173,221,278.993 ton-miles, and the freight-train miles only 526,312.433, an increase of 79,633,167,160 ton-miles, for less than 4 per cent more mileage.

This teaches the correlations between the

enlarged equipment on the stiff and strong rails.

The smoother track on the stiff rails reduces the train resistance by causing the centres of gravity of the wheels to roll forward with limited undulations, and this in turn the centres of gravity of the bodies of the locomotives and cars, one of the important factors in the recent progress of transportation. This fact of track construction and maintenance has not attracted academic discussion, but it does receive consideration and work as the railroad companies look to the physical condition of their tracks and the high standards of maintenance for economy and safety of operations. The expenditure for labor by the railroad companies of the United States in 1903 was \$139,000,000 to maintain the surface of the tracks. This sum represents annually nearly 1 per cent of the total cost of the investment and construction of the railroads.

The permanent way, composed of so many members safely but not rigidly connected, does not become a conservative system in which the strains incident to the passing locomotives and cars may be mathematically traced in their distribution in the rails, cross-ties, ballast, and subgrade, as in bridge members with rigid connections.

The International Railway Congress, at its second, third, fourth, and fifth sessions, had elaborate mathematical papers and discussions upon the subject based upon the consideration of static wheel-loads, then assuming what would take place under rolling loads.

The conclusions were not accepted in this country, in some respects, for they were not in accordance with the results of experience of distributed wheel-loads of American practice.

Prof. A. Flamache, chief engineer of the Belgian railways, considered all of the previous papers, and in the January Bulletin, 1904, of the International Railway Congress, Brussels, presented 30 pages of mathematical investigations, and concludes that the problem of what occurs in the rail under the rolling loads cannot be stated without more instrumental investigations for analysis.

Measurements of the unit fibre strains in the rails under moving trains have not been made abroad.

I ascertain the unit fibre strains in the rails under the moving locomotives and cars by means of my Stremmatograph, an instrument of precision, which segregates five inches in length of the base and records on a phosphor bronze slide the elongation and compression of the metal due to the passing wheel-loads.

The strains are measured under a special microscope, and from the modulus of elasticity of the steel the unit fibre stresses in pounds are ascertained. Then from the factors expressing the mechanical properties of the section the bending moments of the wheel effects are determined, as exhibited in Test No. 257, one of a series of precision, on stiff rails, to trace the distribution of the stresses under the moving locomotives. This seems to be for all the wheel contacts, as though distributed from the centre of gravity of the locomotive, in accordance with mechanics.

The test was repeated for the same train 30 December, and the total stresses compared within less than $\frac{1}{2}$ per cent. The average sum

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of the positive bending moments for both was 11.48 inch-pounds per pound of static load on 5½-inch 80-pound rail. Similar tests upon 6-inch 100-pound rails, at slower speeds, have been secured, of equal precision. The wheels must be perfect, and the engines performing the same work, for tests of precision. Engines with swing trucks do not give high degrees of exactness.

The tests also enable comparisons to be made between the types of locomotives in distributing their loads upon the rails.

At the same place, date, and speed as Test No. 257, a 10-wheel locomotive, weight 282,900 pounds, drawing the "Southwestern Limited," weight 910,000 pounds, the positive bending moment was 9.82 inch-pounds per pound of static load, for one rail. The closer wheel-spacing of the heavier, larger, and stronger locomotive, distributing its expended tractive effort under six instead of four drivers, was easier on the foundation or sub-grade than the eight-wheel type. This had been inferred from practice, and now confirmed by measurements.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

P. H. Dudley's Stremmatograph Tests, 23 Dec. 1899.

No. 257. Track, No. 1. Location, 6° curve 600 feet west of mile post No. 10. Rail 5½ inch, 80-pound. Moment of inertia, 28.5 4th-power inches. Cross ties. Length, 8 feet. Width, 9 inches. Thickness, 6 inches. Wood, Y. P. Weight, 155 pounds. No. 18 per 30 feet rail. Average weight of superstructure per yard, 449 pounds. Three-tie supported joints, 36-inch splice bars, stone ballast. Train No. 51, Empire State Express. Number of cars, 4. Weight, 430,000 pounds. Locomotive No. 870. Weight: trucks, 44,500 pounds; drivers, 86,500 pounds; tender, 89,000 pounds; total, 220,000 pounds. Speed, 42 miles per hour. Temperature, 40° F. The apparent mean unit fibre-stresses in the base of one rail were as follows in pounds:

LOCOMOTIVE			Per wheel.	Per wheel base of			Per lb. of wheel base of	Wheel effects		
ENGINE	TENDER	Drivers and trucks of engine, tender and cars.		Engine and tender.	Locomotive and cars.	Drivers and trucks of engine, tender and cars.		Positive bending moments under wheels. Inch-lb.	Negative bending moments in wheel spacing. Inch-lb.	
LOCOMOTIVE	ENGINE	Truck	Extra wave preceding truck wheel	709						8,083
			Compression in front of truck wheel.....	13,463					153,478	
			Tension under front truck wheel.....	709	23,857			1.072		8,083
			Compression between front and rear truck wheel.....	7,086				80,780		
			Tension under rear truck wheel.....	3,779	83,024		1.369		43,081	
			Compression between truck wheel and front driver.....	20,926				306,957		
			Tension under front driver.....	4,252	59,167				48,473	
			Compression between drivers.....	24,564				280,030		
			Tension under rear driver.....	3,071	127,075				35,017	
			Compression between rear driver and front tender wheel.....	10,157				115,790		
	Tension under front tender wheels.....	0	20,904		0.931		0			
	Compression between tender wheels, front truck.....	8,031				91,553				
	Tension under rear tender wheel, front truck.....	2,362	44,051				26,926			
	Compression between front and rear tender trucks.....	8,976				102,326				
	Tension under front tender wheel, rear truck.....	472	23,147		1.031		5,381			
	Compression between wheels of rear tender truck.....	11,337				129,242				
	Tension under rear tender wheel.....	2,362	34,756				26,926			
	Compression between tender wheel and first car wheel.....	9,684				110,397				
	Tension under front wheel of first car.....	272	33,895		1.310		3,101			
	Compression between first and middle wheel.....	12,764				145,310				
Tension under middle wheel.....	1,417	33,895				16,154				
Compression between middle and rear wheel.....	8,503				96,934					
Tension under rear wheel.....	945	33,895				10,773				
Compression back of wheel.....	0									
Compression in centre of wheel space.....	2,362	33,895				26,926				
Compression in front of wheel of rear truck.....	9,920				113,088					
Tension under front wheel of rear truck.....	1,181	33,895				13,495				
Compression between front and middle wheels.....	8,379				95,521					
Tension under middle wheel.....	2,362	33,895		1.280		26,926				
Compression between middle and rear wheel.....	8,976				102,326					
Tension under rear wheel.....	709					8,083				
Compression between trucks of first and second cars.....										

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Test No. 257.—Reduction of sum of positive and negative bending moments to one pound of static load for one rail:

	Inch-pounds
Engine, sum of positive bending moments...	821,245.00
Engine, sum of P. B. M. per pound of static load	12.65
Engine, sum of negative bending moments.....	125,234.00
Engine, sum of N. B. M. per pound of static load	1.92
Tender, sum of positive bending moments.....	438,911.00
Tender, sum of P. B. M. per pound of static load	9.75
Tender, sum of negative bending moments.....	63,279.00
Tender, sum of N. B. M. per pound of static load	1.40
Locomotive, sum of positive bending moments.....	1,260,156.00
Locomotive, sum of P. B. M. per pound of static load	11.46
Locomotive, sum of negative bending moments.....	188,513.00
Locomotive, sum of wheel effects.....	1,448,669.00
Locomotive, sum of N. B. M. per pound of static load	1.71
First car, sum of positive bending moments.....	663,576.00
First car, sum of P. B. M. per pound of static load	12.52
First car, sum of negative bending moments.....	141,187.00
First car, sum of N. B. M. per pound of static load	2.66
First car, sum of wheel effects.....	804,763.00
Weight of one-half of car, 53,000 pounds.	

The Stremmatograph tests confirm that it is the combined wheel-loads and spacing which produce the specific deflections in the rails, and limit and control them, more than the flexible supports of the cross-ties. This fact is the fundamental principle of the American theory and practice of loading favorably the subgrade through the distribution by their wheels of the total loads of the locomotives and cars. The stiff rails increased this efficiency to such an extent as to empower doubling the axle and total loads of the locomotives and cars, in the past 15 years, and at the same time secure and maintain smoother and better tracks than was possible on the lighter and limber rails.

The correlations of the stiff rail sections and the equipment are demonstrated and established by practice and analysis of tests, for under the wheel contacts in the general depression the positive bending moments are constrained by the negative bending moments, which check the deflections under the wheels, similar to the restrained beam of mechanics. To differentiate between the functions of the rail section and the "restrained beam" of mechanics, I designate the rail section on flexible supports under the rolling loads of the locomotive a constrained beam.

It is unique in the use of material or beams, that by a subdivision of the total load of the locomotives through the progressive wheel contacts, such favorable loading and distribution are made on the rail, and foundation; that the section by the function of its mechanical properties, in combination with its flexible supports and the sub-grade, is stiffened and strengthened—a reciprocal benefit.

This has been so advantageous with the American type of equipment that with all of the increase of axle and total loads, upon the stiff rails, reconstruction of the roadbeds has not been required. The wheel-loads carried are heavier than those abroad, and with the higher speed demonstrate that the essential running stability is secured between the equipment and permanent way, as well as upon roadbeds which

are considered more rigid. Baron Von Weber, director of the state railways of Saxony, in 1869, published a work on the stability of the permanent way, from his tests with engines of three pairs of drivers without trucks. His wheel-loads did not exceed 13,000 pounds, and he concludes, erroneously, that engines with two pairs of drivers would be preferable, and that the cross-tie supports should be replaced by a longitudinal system for heavier wheel-loads. His tests were valuable in many respects, though they did not lead to the consideration of all the elements of the running stability between the equipment and the permanent way, for we are now carrying driving-wheel loads twice as heavy as those in his investigations.

The running stability of the American railroads can be augmented by 9-foot treated cross-ties, screw spikes, and attention to the wheel-base of the engines.

The iron rail sections empowered the establishment of the railroads. The present development, efficiency, capacity, and prosperity has been in the period of the stiff steel rail sections, as engineering structures, and their correlations to equipment and operations of railroads.

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Rails and Rail Shooting. Any birds belonging to the typical genera of the family *Rallidae* are popularly called rails, probably in reference to their harsh rattling cries, but the name is more particularly applied to certain species, others being known as marsh hens, crakes, etc. The family is included in the order *Gralla* or *Gruiformes*. The family is a large one composed of numerous species of moderately sized birds of generalized structure, found in most parts of the world. The body is compressed, the legs strong, the feet very large with long toes, which are lobately webbed in the coots, the wings and tail very short, the bill strong and variously shaped, but never greatly elongated nor provided with a sensitive tip; and the colors are usually obscure and sober. About 35 genera and 180 species of *Rallidae* have been recognized, but authorities differ concerning the retention of some of the more aberrant forms within the family. Three subfamilies are represented in the North American fauna: the *Fulicina*, or coots, with lobate marginal webs on the toes and a horny frontal shield; the *Gallinulina*, or gallinules, with a frontal shield, simple toes, and usually richly colored plumage; and the *Rallina*, or typical rails, in which the family characteristics are best displayed, and there is no frontal shield nor any webbing on the toes.

Most of the rails are marsh-loving birds, their long toes admirably serving to support them on the soft mud, and their narrow compressed bodies facilitating movement among the stems of grasses and reeds. Owing to their skulking and largely nocturnal habits they are difficult to observe, and, except by gunners, their abundance is not generally known. They run well and to escape danger trust to their ability to slip quietly into a place of concealment. They seldom fly, and, owing to the shortness of the wings, only in a weak, uncertain manner, but nevertheless some of the species perform extensive migrations. In feeding they are chiefly carnivorous but never probe the mud for worms.

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etc., in the fashion of snipes, nor strain it as do the ducks. The nest is usually a rude bulky platform of dried rushes, etc., slightly elevated above the wet ground and the numerous eggs are thickly spotted. The young are fully downy and are said not only to run but to swim well as soon as hatched.

Besides the corncrake (*Crex crex*), which occasionally wanders from Europe to our shores, 12 species of true rails occur within the boundaries of North America. They belong to two genera. The king rail (*Rallus elegans*) or fresh-water marsh-hen is our largest species, reaching a length of 18 inches and a wing expanse of two feet. It is known by the rich cinnamon and chestnut hues of the under parts and the strong streaking of the plumage above. This species is abundant in the fresh-water marshes of the eastern United States but, although occasionally seen in New England, is rather southerly. Except for its habitat and the character of its food, which consists largely of aquatic insects, leeches, and wild rice in season, the habits of the king rail closely resemble those of the next species. In the salt-water marshes from Connecticut southward along the Atlantic and Gulf coasts the king rail is replaced by the well known clapper rail or salt-water marsh-hen (*Rallus crepitans*), which is extremely abundant from New Jersey southward and is resident in the southern half of its range, but migratory northward. It inhabits the reed-covered marshes intersected by ditches and creeks which border so much of our coast within the beach line, and its presence is especially evident during the breeding season when the loud clattering cry is heard incessantly both by day and night. All kinds of snails, crustaceans, and worms inhabiting such regions constitute its food. The nest is a heap of dried reeds and grasses elevated just above the water by the side of a ditch, and usually concealed by an artful overarching of reeds. As many as a dozen, but more frequently about eight eggs, are laid; they are oval, of a cream or buff color and thickly blotched with brown and lavender tints. The clapper rail is slightly inferior to the king rail in size and is of a blended grayish color tone, rather than a streaked red. Closely related species are the *R. obsoletus* of California and *R. scottii* of Florida. The Virginia rail (*R. virginianus*) is about 9 or 10 inches long and in color a perfect miniature of the king rail. Unlike the latter it inhabits salt and tide-water as well as inland marshes, and is very widely distributed throughout temperate North America and southward. It is a regular migrant, in most of the Northern States and Canada, remaining from April to September to breed. Although generally common, they are best known by their nocturnal and diurnal cries. In nesting and other habits they resemble the clapper rails, but the eggs are of course much smaller. The Carolina or sora rail or crane and the yellow rail belong to the genus *Porzana*, which differs from *Rallus* in having the bill short and stout instead of long and slender. The former (*P. carolina*) is eight or nine inches long, brownish above and unspotted below, the latter (*P. noveboracensis*) is only about six inches long, with much yellow above and the breast spotted. Both appear to range widely in North America, but the former is everywhere

a far more abundant bird. The sora, also erroneously called ortolan, is the best known and during the migrations the most plentiful of the rails in all suitable reedy marshes along the shores of lakes and rivers, and it breeds in similar localities in the Middle States and northward. A third related species, the black rail (*P. jamaicensis*), is rarely taken. The North American rails are all marsh birds, but the European corn crane prefer the cultivated fields, and in New Zealand and other Southern islands many remarkable forms of field rails and some curious flightless and burrowing species are found.

Rail-shooting in the autumn, when they, and particularly the Carolina rail, congregate in immense numbers in the river swamps, has many followers; but it can hardly be called a sport, being nearly on a par with the annual slaughter of reed birds which occurs at the same time and places. The method is very simple: Each gunner has an assistant who poles him about in a flat-bottomed boat or skiff through the creeks and passages which everywhere intersect the swamps. Usually this is done at high tide, owing to the shallowness of the creeks at other times and because the rising water restricts the area on which the birds can run. Sometimes spaniels or other dogs are employed to drive the birds, but this is unnecessary, as they are easily seen as they run along the banks of the creeks or rise in short labored flight. Enormous numbers, often running into the hundreds, may be secured by a skilful shot who has mastered the problem of shooting from an unsteady boat. During the gunning season the sora feeds largely on the seeds of reeds and wild grains, becomes very fat, and is a truly delicate morsel. The other species are also sought but to a less extent. At times of unusually high tides great numbers of clapper rails are killed along the New Jersey coast as they huddle bewildered on little islands and masses of reeds in the flooded salt meadows. Immense numbers of the eggs of the same species are also gathered for food. Consult: Baird, Brewer, and Ridgway, 'North American Water Birds' (Boston, 1884), and Roosevelt, 'Game Water Birds' (New York, 1884).

Rails and Structural Shapes, Manufacture of. One of the most important branches of the iron and steel industry is the manufacture of rails. Up to about 1855, all rails were made of wrought iron. In England beginning about 1767, various forms of cast-iron and wrought-iron rails were employed, the first being a grooved rail for tramway purposes, which was subsequently developed into the regular railway by the use of cast-iron flanged rails. The first wrought-iron rail was patented in England by Birkenshaw, in 1820, and on account of its peculiar form was known as the "fish-belly" rail. It was the first to be rolled in continuous lengths embracing several spans, and was laid in cast-iron chairs spiked to stone blocks set at intervals of 3 feet. It weighed about 33 pounds per linear yard. Its manufacture by the rolling process, however, was quite difficult, and it was superseded by the "flat-foot" rail which combined a solid head with a flanged base and was laid by being fastened to timber sleepers or ties by spikes driven through the holes in the flange.

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The flat-foot rail was followed by the bridge-rail, the double-headed rail, and the bull-headed rail. The last named, although involving a great waste of metal, owing to the excessive thickness of the web, is used exclusively in England, while in the United States and almost all foreign countries, the rail of the flanged T-section is universally employed. It was invented by Col. R. L. Stevens, in 1830, but the form in use in America is a modification suggested by the special committee appointed by the American Society of Civil Engineers, in 1893; while the form used in Europe is that invented by Sand-

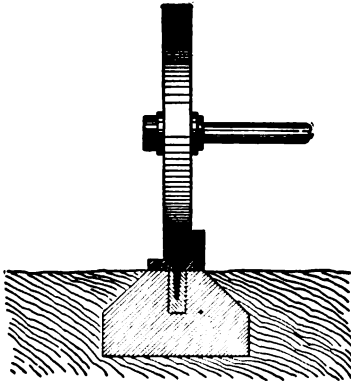


FIG. 1.—Tramway rail.

berg. It is usually made in lengths of 30 feet, but rails as long as 60 feet are used to some extent. In weight, it varies from 25 to 100 pounds per linear yard, according to the amount of traffic, the speed of transportation, and the gradients and curves of the roads upon which it is used. About 1865, a few years following the discovery of the method of manufacturing Bessemer (q.v.) steel, rails of that material were experimentally rolled in the United States and soon began to supplant those of wrought iron. At the present time all rails are made of steel, and they have, probably, contributed more towards the rapid development of this country

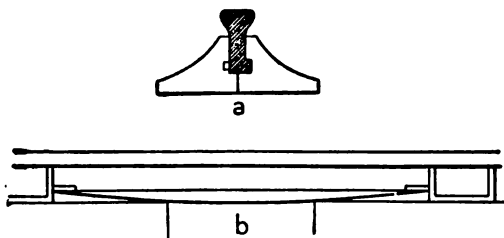


FIG. 2.—Fish-belly rail. (a) Section. (b) Side view.

than any other single product of the steel industry. The raw materials consist of iron-ore, coke, and limestone, mixed in proportions as follows—ore 2 pounds, coke 1 pound, and limestone $1\frac{1}{3}$ pound. Two fundamental processes of manufacture are employed—the reduction of the ore in the blast furnaces and the conversion of the molten metal into steel in the converters, followed by the operations of the rolling mill. (See IRON AND STEEL.) The Bes-

semer process of conversion is generally employed on account of its rapidity as compared with the open-hearth process, taken in connection with its capability to produce a grade of metal of a quality sufficiently high to satisfy the general specifications for rails. In the manufacture of steel rails, the work of smelting the

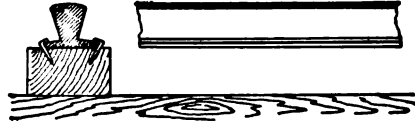


FIG. 3.—Flat-foot rail.

iron in the blast furnaces is continued day and night, year in and year out, without intermission, but the converters and the rolling mills are generally shut down from 1.30 P.M., Saturdays, to 5 P.M., Sundays. During the intervening times, the product of the blast furnaces instead of being poured into the mixers (by which the

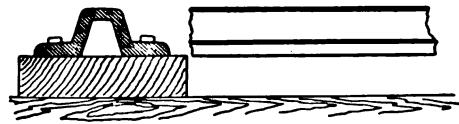


FIG. 4.—Bridge rail.

casts obtained from the different blast furnaces at varying temperatures and qualities, are reduced to a common temperature and quality), are run into the pig casting machine which consists of a series of parallel endless chains of molds arranged to pass in front of the pouring mouth of the ladle. The molds receive the

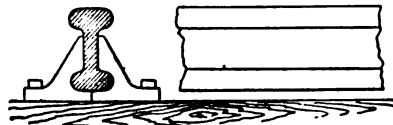


FIG. 5.—Double-headed rail.

metal at the lower end of the chain, and deliver the casts at the upper end of the chain, where they are loaded upon railway cars for shipment.

In the regular work, as soon as the ingot cast from the metal purified in the converters, is set, the mold is drawn from it by a hydraulic

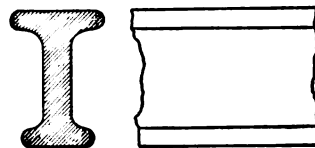


FIG. 6.—Bull-headed rail.

stripper, and it is raised by an overhead electric crane and then lowered into the soaking pit, where it is brought to the proper temperature (white heat) for rolling. It is then taken to the blooming mill and passed through the blooms (rollers) seven times and reduced to a section varying in size according to the size of the desired rail. The section of the ordinary rail used on the railroads is $9\frac{1}{4}$ inches square, and

RAILS AND STRUCTURAL SHAPES

the ingot when rolled to that section attains a length of about 15 feet. It is then sheared into two or three lengths, as the case may be. These pieces called blooms after being heated

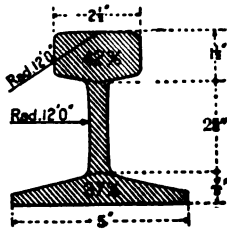


FIG. 7.—Flanged T section rail—80 lbs. per linear yard. Standard Am. Soc. Civil Engineers.

in the bloom furnaces are carried to the rail mill, which consists of three sets of rollers—the roughing rolls, the intermediate rolls, and the finishing rolls, through which the bloom is passed successively. Through the first set it is passed five times and reduced approximately to the section of the desired rail. It is then, without being re-heated, passed five times through the intermediate rolls and reduced more closely to the desired shape. If the rail is of the lighter variety, weighing from 50 to 70 pounds per linear yard, it is then passed through the last set of rolls and finished on a single

In the manufacture of "structural shapes" (a term which includes a great variety of angle-irons, T-irons, I-beams, Z-bars, eye-bars, channel-irons, and built-up posts, beams, and girders), used in the construction of modern buildings and bridges, the shapes are rolled from basic open-hearth steel of three grades—the rivet steel with an ultimate strength ranging from 48,000 to 58,000 pounds; the soft steel from 52,000 to 62,000 pounds; and the medium steel from 60,000 to 70,000 pounds. The elastic limit generally required is not less than one half of the ultimate strength, and the test pieces are required to be capable of being bent over through an angle of 180 degrees, without fracture. The raw materials consisting of ore and pig-iron, are melted down in the cupolas and are then run into the open-hearth tilting furnace, where an equal amount of cold scrap, in the form of steel junk, crop-ends, punchings, etc., from the construction shops, is added. The contents of this furnace, sometimes amounting to 75 tons, are poured into a hydraulic ladle crane, which is then swung over the casting pit, and the molten metal poured into the ingot

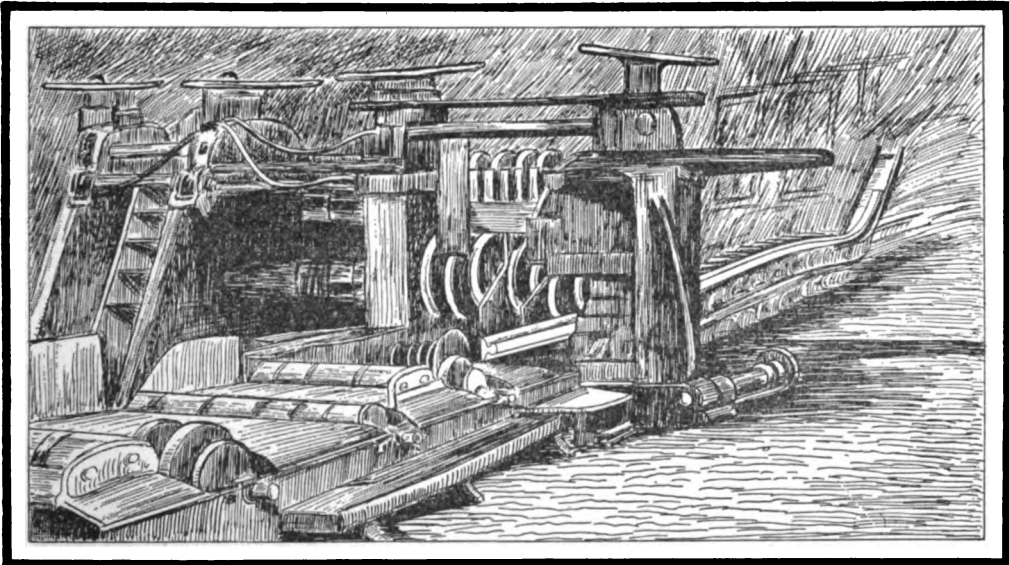


FIG. 8.—Rail passing through the intermediate rolls in the rail mill.

heat, with satisfactory results. But, if the rail is of the heavier class, ranging in weight from 80 to 100 pounds per linear yard, its tendency to retain heat longer, and therefore be passed through the finishing rolls at a temperature too high to give good results, is overcome by allowing it to remain upon a cooling table for an interval of time ranging from 45 to 90 seconds, and it is then passed through the finishing rolls at a lower temperature, thus giving a rail of a much better quality of metal, especially in the head of the rail. The rail is now sawed into the desired lengths, usually of 30 feet, and then passed through the cambering rolls, where it receives sufficient camber to prevent warping when it is being cooled. After being cooled off on the hot beds it is straightened, chipped, and filed, and is then ready for shipment as a finished product.

molds in the usual way through the bottom of the ladle. The ingots when set, are re-heated in the soaking pit, and then passed through the blooming mill and reduced to blooms and billets of any required size. They are then rolled to the desired shapes, sawed into the required lengths, and then cooled on the hot beds. From the hot beds they are passed through the straightening rolls, and after being cut into exact lengths, as required, they are ready for the construction shop.

In the production of finished bridge members, the shapes are carefully laid out by wooden templates, in which the precise positions of rivets, angles, gussets, etc., are marked. The operation of building up requires great care and accuracy. The shapes are sawed or sheared to exact length, and the sides and ends faced and planed down as required by the drawings.

RAILTON — RAILWAY ASSOCIATIONS

The small holes for bolts and rivets are punched by lighter forms of machinery driven by electric power; on the other hand, all pin-holes are first punched and then bored to exact diameter. In assembling, the rivet holes are properly registered, being reamed if necessary, and the separate parts bolted together, and finally riveted up by hydraulic, or pneumatic riveters. (See METAL-WORKING MACHINERY.)

In the manufacture of eye-bars, used in bridge construction, the tensile strength is limited to not more than 10,000 pounds below the test specimen of the grade of steel from which they are rolled. The eye-bar heads are formed by upsetting machines operated by hydraulic power, in which the heated end of the eye-bar is pressed to the desired circular form by the three-fold die of a hydraulic press, in a single operation. The head is then forged and punched at one heat, and then finished bored. Eye-bars are tested in a hydraulic testing machine capable of exerting a maximum pull of 700 tons. When an order of eye-bars is completed, one of the bars is pulled asunder in the machine. In general, they are required to show not less than 10 per cent elongation in the body of the bar, and they must break in the body and not in the eye.

W. MOREY, JR.,

Consulting Engineer, New York.

Rail'ton, Herbert, English artist: b. Pleasington, Lancashire, 21 Nov. 1857. He was educated at Mechlin, Belgium, and Ampleforth College, Yorkshire, and is very popular as an illustrator, among works which he has illustrated being the 'Jubilee Edition of Pickwick' (1887); 'Westminster Abbey' (1889).

Railway Associations. In the early days of railways their operation was but little more difficult to regulate than the service of the ordinary highway. The trains, few in number, were formed of connected stage coaches, or wagons, and were drawn sometimes by horses, sometimes by light locomotives. As traffic increased, trains multiplied, vehicles were enlarged, and the powerful engine of the present date, capable of hauling a train of a hundred modern freight cars, was eventually evolved. This great physical change has required a coincident development in rules and regulations, in order that the immense traffic of modern times, with its complicated movements over an interlaced system of roads, may be operated safely and efficiently. In this development each railway company formerly moved independently. The knowledge acquired by the officials of one company as the result of experiment and experience was unknown to the others, rarely communicated and sometimes jealously guarded. The problems presented eventually became so many and so intricate as to render the exchange of ideas and experience advantageous, if not imperative. This exchange has been mainly accomplished by means of railway associations. In no other line of business and in no other country has this co-operative work been developed so completely and so scientifically as among the railways of North America. It has been of incalculable value to the railway companies and to the traveling public.

There are more than 20 railway associations, national in their character, in North America; most of them are devoted to subjects connected

with operation and the others to questions concerning traffic. The term "operation" includes the supervision of the movement of trains, the maintenance of the superstructure, buildings and rolling stock and the exercise of discipline. The term "traffic" refers to business concerning rates and regulations affecting passengers, freight or other articles transported. Of the organizations devoted to "operation" the most important and influential is The American Railway Association, which had in 1903 as its members 218 railway companies, operating 212,849 miles of railway,—about 95 per cent of the entire railway mileage of the United States, Canada and Mexico. The history of The American Railway Association has been one of gradual development. Dating as far back at least as 1872, joint meetings of operating railway officials of superior grades were held semi-annually, with more or less regularity, having for their object the mutual arrangement of the schedules of through passenger trains between the east and the west and intermediate connections. Aside from such business, the first important co-operative work of this body, then called "The General Time Convention," was the approval of a detailed system of Standard Time proposed in April 1883, and its practical adoption in the United States and Canada on 18 Nov. 1883. Previous to that date every railway ran its trains by the local time of the city in which its headquarters were located, or some other arbitrary standard. There were over 50 standards in use, differing from each other by odd numbers of minutes. On the date named these were resolved into four standards based upon Greenwich meridian time, with differences of an even hour between them. Cities and towns throughout the country generally conformed their time to the new standards. Prior to 1883, the hand, lamp, whistle, color and bell cord signals in use upon the railway trains varied greatly. In some instances a motion of the hand or flag or the sound of the whistle would convey exactly opposite meanings to employees of different roads which used the same terminal stations for their trains. Bell cord and other signals were similarly at variance. A code of uniform train signals was adopted by the convention, taking effect 16 Nov. 1884. A similar organization of the operating officials of the railways between New York city and points in the South, called the "Southern Railway Time Convention," was formed on 24 Oct. 1877. This body accepted and approved the action of the General Time Convention with respect to standard time and uniform train signals, and co-operated in their adoption. On 14 April 1886, these two bodies were consolidated and a national organization formed, called "The General Time Convention." The name was changed to "The American Railway Association" in April 1891.

The object of the American Railway Association is the discussion and recommendation of methods for the management and operation of American railways. Its action is recommendatory, and not binding upon any member. Any common carrier operating an American steam railway is eligible to membership, subject to the approval of the executive committee. While any official of a member may be admitted to its sessions or serve on committees, the ranking official, who may be the president, vice-president,

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general manager, etc., casts the vote of the company or designates who shall cast it. Meetings are held semi-annually, in April and October. The work of the association is mainly accomplished through committees, and it is one of their functions to decide questions which arise in practice under the code of rules and to propose new rules to meet the great advances that are being made year by year in the methods of operation. Its technical standing committees are those on the subjects of train rules, car service and safety appliances. They examine into and report upon questions affecting the Standard Code of Train Rules, the movement of, distribution and accounting for cars, and the essential requisites of devices for safety appliances. Formerly each road had its own code of train rules. An employee, expert in the service of one road, found his knowledge useless on entering the service of another because the practice under the rules of the two was diametrically opposite. From the badly constructed and often discordant rules that preceded it, a scientifically arranged Standard Code of Train Rules was formulated, which each road could adopt and which most have adopted. This code has a glossary of technical terms and is divided into single-track rules for the movement of trains with or without the use of the telegraph; for movements by telegraphic train orders, with forms of orders; double-track rules; block signals and interlocking rules; for movements with the current of traffic on double track by means of block signals; and for movements against the current of traffic. In carrying merchandise from one part of the country to another the interchange use of the 1,700,000 freight cars belonging to the railway companies reaches enormous proportions. For many years the owner of the car was paid by the company using it at a rate based upon the miles it moved. Of recent times this was six tenths of a cent a mile, the account of the movement being kept by the company which paid for it. Complaints were frequent of long detentions of cars without compensation to their owners, causing delays affecting the transport of merchandise. Many attempts were made to bring about a change, but nothing practical was accomplished until The American Railway Association adopted a Code of Per Diem Rules in April 1902, and obtained the assents of the majority of the railways to a "Per Diem Agreement," taking effect on 1 July 1902. This provided for the payment of 20 cents a day for the interchange use of freight cars, with a penalty rate of an additional 80 cents per day for the detention of a car over 30 days upon one road. Provision was made for the arbitration of differences arising under the rules and for their interpretation. A code of car service rules governs ordinary practices connected with this interchange service, not related to the compensation paid as above referred to. The essential requisites for train heating, train lighting, automatic couplers, power brakes, for the installation of block and interlocking signal apparatus, etc., have been prescribed. The educational and physical qualifications for employees have been carefully considered. The Association prescribed the standard height of draw bars for freight cars, under the act of Congress approved 2 March 1902. The following

subjects have been at various times considered by special committees: the 24 o'clock system; the transmission of accurate time; uniform car mileage reports; general regulations for employees; standard wheel and track gauges; the metric system; railway statistics; standard box cars, and uniform cipher code. Uniform rules for the government of local car service (demurrage) associations were approved April 1898, and various recommendations of the Master Car Builders' Association have been submitted to and approved by The American Railway Association. The association is a member of the International Railway Congress, and sent delegates to its sessions in London in 1895 and Paris in 1900. It appointed an "American Section" to take charge of the arrangement for the seventh session of the Congress, to be held at Washington, D. C., in May 1905.

The Master Car Builders' Association is one of the oldest of these railway organizations. It was organized in 1867, and had 533 members in 1903. Its objects are the advancement of knowledge concerning the construction, repair and service of railroad cars, to bring about uniformity and interchangeability in their parts, and to adjust the mutual interests growing out of their interchange and repair. Its action is recommendatory, and not binding upon any of its members. A superintendent of the car department, master car builder, mechanical engineer, foreman of railroad car shop, joint car inspector or a representative of a car manufacturing company or other company owning over 1,000 cars, may become active members. Persons accredited by a railway company, and who have a practical knowledge of car construction, may become representative members. Such members, in addition to the vote of an active member, have one additional vote for each 1,000 cars owned by the company represented, upon all questions pertaining to the adoption of standards, etc. The membership includes many persons who are also members of the Master Mechanics' Association, and it is customary to hold the annual meetings of the two associations at the same place, one following the other. In the interchange of cars between railroad companies, questions of responsibility for repairs caused by accidents or by ordinary wear and tear are continually arising. In order to facilitate the settlement of such questions the Master Car Builders' Association has provided a code of rules governing the condition of and repairs to freight cars. Each company is required to give the same care to the cars of other companies in its possession, technically called "foreign cars," as to its own cars. Cars offered in exchange service must be accepted, unless found to be defective as specified in detail in the rules. The rules include instructions as to methods of making repairs and billing the expense to the owners, with schedules of charges for labor and materials. For the settlement of all disputes arising under the rules an arbitration committee is provided. This association brought about the selection of the type of automatic coupler, now in use upon the railway cars in North America. It has also adopted standards, both for the construction and use of cars, which have proved of great value. These standards, 23 in number, are fully illustrated and published with

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each volume of its proceedings, together with 12 additional charts containing diagrams of recommended practices.

The American Railway Master Mechanics' Association was founded in 1868, is incorporated, and had 755 members in 1903. Its objects are the advancement of knowledge concerning the principles of construction, repair and service of the rolling stock of the railways. It considers questions affecting such joint action as may be required to give the greatest efficiency to the equipment of railways. Those eligible to membership must have positions above the rank of general foreman, having charge of the design, construction or repair of railway rolling stock; general foremen, if their names are presented by their superior officers, and two representatives from each locomotive and car building works. Persons having knowledge of science or practical experience in matters pertaining to the construction of rolling stock, may become associate members. The subjects assigned to committees for 1903-4 were as follows: Ton mile statistics; coal consumption in locomotives; locomotive front ends; locomotive driving and truck axles and locomotive forgings; boiler designs; revision of standards, such as shrinkage allowances, specifications and tests for boiler tubes; air brakes and signal instruction; piston valves; electrical equipment of shops and power houses; automatic stokers; locomotive frames; cost of locomotive repair shop; and safety appliances for locomotive front ends. The proceedings of the association contain a technical illustrated history of the development of locomotives, shop engines and machinery, from the date of its organization. The association has established four scholarships at the Stevens Institute of Technology.

The International Association of Car Accountants and Car Service Officers was organized in 1876, has 180 members and meets annually. Its object is the improvement of and the establishment of uniform practice in methods of car accounting and car service. The compilation of the statistics of operation of each road requires that the movement of cars, both loaded and empty, shall be accurately recorded. The interchange use of the 1,700,000 freight cars in service between the railway companies involves an immense amount of detail work in keeping and settling the accounts. Since the value of a freight car as a vehicle of transportation based upon its average earnings is between \$2 and \$3 a day, the importance of the figures involved in this accounting is self-evident. This branch of the service is part of the operating and not of the general accounting department. An official publication called the 'Railway Equipment Register,' contains lists of the cars of the several companies, giving in detail their numbers, dimensions, capacity and kind, such as box, flat, coal, etc., and other information essential to operating officials in regulating car movements and in car accounting under the rules of the association.

The Railway Transportation Association has for its object the development and solution of problems affecting transportation in the mutual interest of railway companies. It was organized in 1899, meets semi-annually and has 58 members, representing the owners of over 1,000,000 freight

cars. Aside from general transportation topics, it considers such subjects as the responsibility for the transfer of freight interchanged; the handling of high class freight trains; the limits of class and size of freight cars; the interchange and distribution of equipment; tonnage; the loading of freight cars to their full capacity, etc. As the object of this association and that of the Car Accountants' Association somewhat overlap, and many officials are members of both bodies, a consolidation into one of enlarged scope, to include the objects of both, is probable.

The Association of Railway Telegraph Superintendents was organized in 1882, has 112 members, and meets annually. Its object is the improvement of the telegraph service. Its membership consists of persons who are connected with the telegraph, telephone, electric light, electric power or electric signal department of any railroad company. It has committees on the following subjects: telegraph cipher code; typewriter in railway telegraph service; and on composite circuits. The duties of telegraph superintendents cover the maintenance of the telegraph lines, as well as the supervision of the operators in the service.

The Train Dispatchers' Association of America has for its object the consideration of the best method of moving trains by telegraph, the establishment of a bureau of information, and the advancement of train dispatchers in efficiency in the performance of their duties. It was organized in 1888, is incorporated, has 868 members, and meets annually. The movement of trains by telegraphic orders, as commonly practised in North America, is unknown in Europe. The details of such movements are directed by designated telegraph operators, called train dispatchers, under the direction of a chief train dispatcher, attached to the staff of the superintendent, by whose authority the orders are given.

Associations of Surgeons.—It is customary for railway companies to retain in their service the services of experienced surgeons located at points on their lines, who are expected to be immediately available in case of accident to employees or passengers, some one of them being often designated as Chief Surgeon. In addition to this duty, hygienic questions are submitted to them, and their services are sometimes employed in the examination of men seeking to enter railway service for color blindness or other physical disabilities. They have two organizations, the International Association of Railway Surgeons, with 670 members, formed in 1888, and the American Academy of Railway Surgeons, with 141 members, formed in 1894, and their consolidation is probable. Their objects are the development and improvement of railway surgery, especially by the study and investigation of clinical, medico-legal and sanitary subjects relating thereto.

National Association of Car Service Managers.—For the purpose of supervising the movements of freight cars especially at terminal and junction points, so as to prevent their undue detention in loading or unloading, Car Service Associations, composed of the railway companies centring or connecting at such points have been organized under rules approved by the American Railway Association. Each local organization is in charge of an official called the

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car service manager. Thirty-nine of these officials organized a national association in 1890 for the purpose of obtaining a general exchange of views as to the best methods of conducting the business and to secure harmony of action.

The Railway Signal Association was organized in 1897, has 355 members, and holds five sessions per year. Its object is the advancement of knowledge concerning the design, construction, maintenance and operation of railway signaling appliances, by discussion, investigation, and reports of experience, for the purpose of systematizing and improving signaling practice. Its membership consists of those persons who are connected with the designing, construction, maintenance or operation of signals. The signal department of railways is one of the youngest and most rapidly developing branches of the service. The subjects considered by its committees are: circuits for automatic block signal systems for steam and electric railroads; for manual block signal systems; for interlocked signals; and for drawbridges; on what shall be considered cost in estimates for installation and records of maintenance; on the use of copper or iron for pole lines; on standards, definitions, nomenclature, office records and accounts.

The American Railway Engineering and Maintenance of Way Association was organized in 1899, has 425 members, and meets annually. Any civil, mechanical or electrical engineer, who has had five years' experience in the location, construction or maintenance of railways, or an official responsible for the maintenance of way, from general manager to division engineer, or whatever may be his title, is eligible for membership. Its working committees are assigned to the following subjects: graduation; ballasting; ties; rail; track; buildings; bridges and trestles; masonry; signs, fences, crossings and cattle guards; signaling and interlocking plants; reports, records and accounts; uniform rules, organization, titles, code, etc.; water service; yards and terminals. One of its purposes is the establishment and maintenance of a library of information concerning maintenance of way matters.

Other national associations of railway officials and employees of the operating department organized for the improvement of the service comprise: Superintendents of bridges and buildings; master boiler makers; master car and locomotive painters; railway air-brake men; master blacksmiths; roadmasters; traveling engineers, dining-car superintendents, and local freight agents. There are also numerous local organizations, such as the Chicago Association of General Superintendents, the Central Association of General Railway Officials, with divisions in Cincinnati, Columbus, Indianapolis, Kansas City, Peoria, Saint Louis and Toledo; the Central and Western, and the Eastern Association of Car Service Officers; Eastern Maintenance of Way Association; Canadian Roadmasters' Association; Buffalo Railroad Association. Railway Clubs, organized for the discussion of technical railway questions, are located at Atlanta, Boston, Buffalo, Chicago, Colorado Springs, Denver, Des Moines, Ia., Macon, Ga., Montreal, New York, Pittsburg, Richmond, Va., Saint Paul, Saint Louis and San Francisco.

The American Association of General Passenger and Ticket Agents, organized 13 March 1855, is the oldest railway organization in America. The ranking officer of the passenger department of each railway corporation and transportation line is eligible to membership. It had 174 members in 1904 and meets annually to discuss matters of general interest to the passenger department. Through this association the American system of interline coupon tickets was introduced, by which passengers are able to purchase tickets from each principal point to all other principal points on the continent. This system has been perfected in North America as in no other country in the world. The association has also prepared standard forms for railroad tickets, and has an organization for the better protection of tickets against alteration, forgery, etc. Formerly the meetings were held to arrange the rates of fares over through routes; but this duty is now performed by local organizations composed of lines operating in separate districts, namely, New England Passenger Association, Trunk Line Passenger Association, Central Passenger Committee, Western Passenger Committee, Trans-Continental Passenger Committee, Southeastern Passenger Committee, etc.

The American Association of Traveling Passenger Agents, organized 17 April 1872, has 867 members and meets annually. Its membership consists of authorized representatives of railway and steam navigation lines, who travel for the purpose of soliciting passenger traffic. Its objects are to suggest such reforms in the railway passenger service as experience may teach to be beneficial to both members and the interests which they represent.

The American Association of General Baggage Agents, organized February 1882, is composed of the general baggage agents of the several transportation lines. It had 67 members in 1904, and meets annually to discuss questions connected with the transportation of baggage, with the view of securing the greatest efficiency, as well as uniformity of practice, in allowance for weight carried free, methods of tracing baggage lost in transit, facilitating its prompt handling, etc.

The Association of American Railway Accounting Officers, organized in 1888, consists of the chiefs and assistants of the various departments of railway accounts. It had 378 members in 1904, representing 223 companies, and meets annually. It is general in its character, rather than a traffic organization. Its objects are the better organization and conduct of the accounts of transportation lines; to aid in securing more perfect means of determining balances between the companies and greater definiteness and promptness in paying the same; greater uniformity in the method of adjusting joint accounts; more equitable plans for settling claims between carriers; greater certainty and promptness in collecting freight charges at competing points; better means of adjusting balances at junctions where freight is rebilled; to obtain greater uniformity, wherever practicable, in the governmental reports required of railroads; and the more general systematization of railway accounts.

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The Association of Railway Claim Agents was organized in 1890, has 346 members, and meets annually. It consists of the officers and their assistants who have charge of the investigation of claims for damages (other than freight), their adjustment or defense. Its object is the interchange of experience and the discussion of any subject of interest to railways in the department represented by its membership.

The Freight Claim Association was organized March 1892 by the consolidation of local associations for kindred objects, which had been in existence since 1887. Its membership consists of the general freight or claim agents or other authorized representatives of the general freight or freight claim departments of railroads, transportation lines or companies, including 237 members, representing 181,000 miles of railway. Object: the prompt and equitable settlement of freight claims with claimants and between carriers. This association has formulated a code of rules for the settlement of claims of every variety arising for loss or damage to freight in the handling of traffic. It has an Arbitration Committee which acts as a court for the interpretation of the rules as applied to such questions in dispute as may be referred to it by the parties in interest. W. F. ALLEN.

American Railway Association.

Railway Bridge Designs. See BRIDGE DESIGNS, RAILWAY.

Railway Car Braking.—To ascertain the time when the question of braking first came into prominence we need go no further than the period when highways became sufficiently well made and maintained as to admit of a heavy vehicle being drawn over them at comparatively high speed. Country roads everywhere as late as 1725 were in a most deplorable condition, being narrow and full of ruts and stones. During the middle of the 18th century there was considerable agitation for better roads, which seemed to have a beneficial effect, since during the latter part of this century the first mail coaches, or "Diligences," were placed upon the roads between London and various cities of Great Britain.

It is a noticeable fact that, with, all kinds of conveyances, the question of braking has increased in importance as the demand for higher speeds increased. During the century from 1770 to 1870 there were granted in England nearly 200 patents for various kinds of braking appliances for common road vehicles; of these 46 were applied to the periphery of the wheel; 28 on the nave, 27 were actuated by the movement of horses, 21 were applied to fly or brake wheels, 8 were applied to the axle, 10 were actuated by a spring, 4 were automatic, 3 electromagnetic, 3 pneumatic, 4 relying on momentum, and 3 accumulated power for subsequent propulsion, etc. In America there had been nearly as many such patents, 21 of which were for automatic designs.

In connection with common road vehicles it is noted that the first devices adopted are those which have formed the basis of almost all brake appliances which have since been employed for the same kind of vehicle. The

early stage coaches and even the later mail coaches were provided with an iron shoe which slips under the wheel and is chained to the fore part of the coach, so as to drag both shoe and wheel along over the surface of the ground. This method of braking was one of the first devices adopted, and is used extensively to-day. The old arrangements of two brake blocks and a beam with suitable levers connecting each to the driver was also early introduced, and all kinds of developments from this arrangement are seen to-day on various kinds of vehicles.

Many primitive forms of brakes were applied to such railroads as existed, but the speeds employed on these roads were generally low and the cars small enough to be drawn by draught animals, and the question was not a particularly serious one until the advent of the steam locomotive. The great revolution which the knowledge of the power and use of steam has brought about was well under way during the first part of the 19th century. During the first 70 years of the century about 650 patents were granted in England for various kinds of brakes for railroad service. In 1833, Stevenson patented his steam brake, consisting simply of a small cylinder containing a piston, the rod of which connected through a system of levers to a cam brake. The first pneumatic brake was a vacuum brake, patented by James Nasmyth and Charles May in 1844. In 1848 Samuel C. Lister patented an air brake, having an axle-driven pump and suitable reservoir to be placed on the "guard's carriage," and suitable cylinder, pipe and connections on the various cars to constitute a straight-air equipment.

Many interesting and ingenious contrivances were suggested and patents obtained for same in the United States. The "Cramer" brake, which was brought into use in 1853, consisted of a large spiral spring attached to the brake staff at the end of the car, and which was wound up by the brakeman immediately after leaving a station. The "Loughridge chain brake," which came into use in 1855, consisted of a system of rods and chains continuously connected throughout the train. These types were the results of much research. There were many other forms of brake which attained a certain degree of prominence, and were more or less successfully operated upon different roads throughout the country.

In 1869, the Westinghouse non-automatic air brake, which has since generally been designated as the "straight air" brake, was brought out. It consisted of a simple steam-actuated air pump placed upon the side of the engine, and a reservoir in which the compressed air could be stored. A pipe line from the reservoir was carried throughout the length of the train, connection between vehicles being made by means of hose and couplings. Each vehicle was provided with a simple cast-iron cylinder, the piston rod of which was connected to the brake rigging in such a way that when the air was admitted to the cylinder the piston was forced out and the brakes thereby applied. In the engineer's cab

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there was placed in the pipe line a three-way cock, by means of which compressed air could be admitted to the train pipe, and thus to the cylinders on each car; or the air already in the cylinders and train pipe could be discharged to the atmosphere, thus releasing the brakes.

This was the simplest and most efficient brake that had been introduced up to that time, and was largely adopted by American railways; but while all that could be desired for single vehicles, the danger incident to the entire loss of braking power when most needed, due to the bursting of hose under pressure, the parting of the train or other rupture of the brake system, led to the invention of the automatic brake. The first form of this brake was introduced in 1872, and is now generally referred to as the "plain automatic." The essential difference between this brake and the "straight-air" type, which it superseded, consisted in the installation of supplementary or auxiliary reservoirs for the storage of compressed air on the cars in addition to the main reservoir on the locomotive, so that each vehicle carried its own supply, and the employment of a most ingenious valve mechanism, by means of which the application of the brake was caused by the reduction of air pressure in the train pipe, whether such reduction was made intentionally or as the result of accident.

The original three-way cock in the engineer's cab has been lately replaced by a more elaborate valve known as an engineer's brake valve. The necessity for this substitution was due to the fact that in applying the brakes the reduction of pressure in the trainpipe had to be more carefully made than was practicable with an ordinary three-waycock. The brake valve was arranged so that in releasing the brakes, air was allowed to flow from the main reservoir on the engine into the trainpipe and auxiliary reservoirs. The engineer by moving the handle to the application position connected the trainpipe to the atmosphere through very carefully graduated openings, and the pressure gauge connected to the trainpipe showed how much reduction was made, and indicated, therefore, the amount of air that would flow from the auxiliary reservoirs into the brake cylinders.

The immense advantage to railway companies along the line of higher speed, greater safety and pronounced economy in the substitution of a reliable automatic power brake under the control of the engineer for the old hand brake was soon recognized, and the work of making this change proceeded rapidly throughout the entire country. Naturally enough, the new conditions encountered brought to light new problems, the solution of which enlisted the best efforts of railway officials and brake manufacturers alike. In many instances it was found that the only possible way to determine the questions involved with any degree of satisfaction was by means of practical tests made under conditions found in actual service.

Very recently, the greatly increased speed of all classes of passenger service, coupled with the demonstration that in order to approach

a uniform rate of retardation it was necessary to have a much higher brake-shoe pressure for high speeds than for low, rendered imperative the "high-speed brake." This apparatus consists of the quick-action automatic brake, with the addition of an automatic reducing valve connected to the brake cylinder. The normal train pipe and auxiliary reservoir pressures are raised from 70 pounds (the ordinary quick-action pressure) to 110 pounds. The reducing valve is arranged so that in service applications the brake cylinder pressure cannot exceed 60 pounds, but in emergency application the initial cylinder pressure becomes nearly 90 pounds, which is gradually reduced as the speed decreases, until 60 pounds is reached, which pressure is retained until released by the engineer. This high-speed brake has reduced the distance within which a train can be stopped by at least 30 per cent. See RAILROAD SYSTEMS.

EDWARD S. FARROW,

Consulting Railroad and Mining Engineer.

Railway Car Cleaning. From the early days of railroading until the present time constant attention has been given to the requirements of sanitation of passenger cars, and how best to insure cleanliness has been a problem with no easy solution. The old method of car cleaning with a whisk here and a dash there with a broom or duster, was not only unsanitary, but unsatisfactory for the reason that it had the effect largely of removing dust and dirt from one section, and depositing it elsewhere; but under the latest and most highly approved method, which is termed the "Vacuum Sweeping System," the dirt and dust are drawn from the car by suction through a pipe.

Prominent railroads have recently erected immense vacuum plants in their car yards, and for distances of several thousand feet have laid pipes varying from two to five inches in diameter. At short intervals this pipe is tapped and from these cocks is run the flexible hose, which may be taken in the car, either by door or window. At the foot of the hose is a metal pipe with a flat triangular end, along the base of which is an opening, and through which the dust and dirt are drawn by the vacuum or "drawing-in machine" located a distance away. The operator runs the slot opening over the cushions, carpets, curtains, woodwork, etc., and without any commotion or dust raising, every loose particle or germ is whisked away, everything being left clean and wholesome. The dust thus removed, before reaching the "drawing-in machine," passes through two dust separators, the first of which clears the air of 90 per cent of the grit, dust and germs; the second separator or cylinder draws the air through water in which corrosive sublimate is used, and completes perfectly the purification. Railroad managers have for a long time felt the necessity for a more sanitary method of car cleaning, and the vacuum system, while reducing disease liabilities to a minimum, at the same time reduces the cost of cleaning and time consumed. Two cars can be thoroughly cleaned under the new system at the same expense of time and money as was formerly consumed in cleaning one.

The only valid objection to the vacuum system is the cutting out the pile of the plush very much

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more rapidly than the process of hand beating, there being more or less sand in the cars. In Jersey City, where perhaps the largest number of cars are cleaned, the other methods in vogue are essentially as follows: (1) The carpets are removed by rolling them in bundles, and then taking to the cleaning shed. (2) The seats, cushions, pillows, mattresses, and blankets are removed to a shed alongside the car, where they are beaten, dusted, and aired. (3) Men go through the car and dust all portions, including the upper berths, with feather dusters, immediately after which the upper berths are closed. (4) The charwomen wash the woodwork and glass with lukewarm water and castile soap. The rugs, particularly those of the smoking compartments, are, if badly soiled, washed with soap and water and then dried. The cars cleaned in Washington and Jersey City are treated in this way every other trip, being only swept at the end of each run.

This vacuum cleaning process has of late been successfully applied in the New York Subway, where it has been demonstrated that a suitable car fitted with a plant can clean one of the stations in less than half an hour, and that while running between stations it can take up the loose dirt from the roadbed and dump it in the yard at the terminal after all the stations have been swept.

Railway Consolidation. The consolidation—or as the English say, the amalgamation—of railways consists either (a) in uniting connecting lines into one continuous line, or (b) in uniting parallel or competing lines into a system. Railways in the United States were originally built for the most part in short, disconnected lines—little stretches of road from A town to B town. Construction had progressed only a little before the desirability of connection between these lines became obvious. And almost at once such connection began to be arranged, so that, in the progress of our railway building and some time prior to about 1870, a great number of these little lines in every part of the country had been amalgamated, with the result of developing our great trunk line systems. Before we had entered upon the last quarter of the 19th century, it had come to pass, speaking generally, as a result of this tendency to unite connecting lines, that very much the greater and more important part of our railway system consisted of long lines of road under a single management or control, made up, especially in the older parts of the country, of a less or greater number of formerly disconnected and independent local lines, which had been one after the other taken over and incorporated into the greater continuous line or system. Almost all the valuable and well located local lines had, 30 years or more ago, thus been absorbed into larger and less local combinations. Such consolidation, working only benefit to the public and demonstrating its usefulness as it went along, provoked only a small amount of opposition, and these amalgamations of connecting lines usually secured legal sanction, whenever necessary, without the protest of the politicians. But about 1870—now a full generation ago—a tendency in the direction of the consolidation of parallel and competing lines developed. What had long been known in Europe

to be the true law of railway construction, and the sound basis upon which railways must ultimately come to exist and be operated in every country where there is enough wealth and commercial activity to make them successful—namely a division of territory and the practical elimination of competition between parallel lines in the same territory—began to assert itself and to be felt to be applicable here: and directly we entered upon a period of consolidation, not now of connecting but of competing lines; and, summing up the whole matter in a single sentence, that process of amalgamation, having now gone on in this country for nearly 40 years, it results that we are now at the end substantially, of the second stage of railway combination.

First, we built isolated and disconnected local lines; second, we united these connecting lines—whenever they did connect—into continuous lines; and third, we divided up the territory between theretofore competing lines, by gradually amalgamating either the ownership or the control of such lines in a defined territory, thus securing little by little to a single interest, a territorial monopoly of the carrying services of the locality. This process carried out to its logical conclusion roughly divides the whole country into railway territories of greater or less extent, within each of which one single railway system is paramount or absolutely controlling. This readjustment of ownership and control between the greater railway companies of the country goes steadily on. In some sections of the country it seems to have been fully and finally accomplished; in other sections it is in progress; and only where the game isn't worth the candle or where the work has been done, is there an absence of activity in this direction, the tendency so to consolidate, first connecting and then competing lines, has been universal and inevitable, and such consolidation is in the one case an accomplished fact and in the other an irresistible evolution. Very little effort was made to prevent the earlier consolidations, that of merely connecting lines. It is now well understood that such efforts, if they had been made, would have failed, and it is now not questioned that such consolidations have been beneficial both to the public and the railways. On the other hand a very great deal of effort has been made by courts and statutes to prevent and hinder the second form of consolidation, that of competing or parallel lines. These efforts have also for the most part failed, and it is now coming more and more to be believed that they will ultimately wholly fail to prevent what seems to be the inevitable in railway development. Moreover, in the case of the amalgamation of connecting lines, the mischiefs which have been apprehended have generally not been realized; so that now not only most practical railway men, but many students of the railway problem believe that in the outcome the balance of benefit both to the carrier and to the public will be also found on the side of territorial division between competing lines.

The history of railway construction and combination throughout the world seems to indicate *first* that the consolidation of competing lines is inevitable; *second*, that efforts by legislation or litigation to prevent it always fail:

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and *third*, that such consolidations benefit both the public and the railways. The facts and figures concerning these consolidations in the United States are detailed elsewhere in this work, but the economic questions involved are still open ones with us. Elsewhere throughout the world these questions seem to be settled. Thus in England, where the railway problem has in many of its features been strikingly like our own, the question is now quite at rest. In France the question never really arose, and elsewhere in Europe it has been decided everywhere in favor of amalgamation and against the continuation of competition between lines serving the same territory. (The writer's argument in the Supreme Court of the United States, October Term, 1903, upon the appeal of *The Northern Securities Company et al v. the United States*.)

England.—In February 1872, a Select Joint Committee on Railway Companies Amalgamation was appointed by the two Houses of the English Parliament to investigate and report back the condition of the railways of Great Britain, particularly in respect of the consolidation of lines and the division of territory among the greater companies. Mr. Chichester Fortescue, in moving the appointment of the Select Committee in the House of Commons, on 23 Feb. 1872, said that "twenty years ago a Committee had reported against the system of amalgamation, but since that committee reported amalgamation had gone on as merrily as before—the fact being that 5,000 miles of railway had been added to the greater railways since that time."

This committee called a great number of witnesses and went fully into the details of the matter throughout the British Islands, and on 2 Aug. 1872, presented a voluminous report, from which it appeared that by the end of the year 1843, 71 separate and independent lines had been constructed, averaging about 30 miles each in length. During the following year the average mileage per independent line was reduced one half, so that by the end of the year 1844 the average was only about 15 miles. Between 1844 and 1847, 637 separate companies had been chartered, with a total authorized length of about 9,400 miles of line. Eleven proposals, for example, were made to Parliament for lines of railway through a single narrow valley, where but one line was possible. This called so loudly for relief that consolidation began about 1847, and so proceeded, by the gradual absorption of the smaller lines by the larger systems, and by a consequent division of territory between the consolidated companies, that by 1872 it had come to pass that the railway business of the Kingdom was substantially performed by no more than about six of these great amalgamated companies. The first English railway charters contained provisions intended to prevent competition both between the lines themselves and between them and the canals, especially in freight traffic. George Stephenson, the father of English railways, seems to have appreciated clearly the mischief to be avoided in the matter of competition, even at that early day, and he, therefore, set himself to the task of getting the railway system in that country started right in this particular. His view on this subject was summed up in his

much-quoted saying that "where combination is possible, competition is impossible."

In 1836, a Mr. Morrison, M. P., from Inverness, made a remarkable speech in Parliament, in the course of a discussion of the then English railway situation, in which he pointed out with uttermost clearness that a railway must in the nature of things be a monopoly; that competing roads will inevitably combine; that parallel lines are sheer waste of capital, and that fixed maximum rates are useless. This utterance is the more remarkable because it stated clearly, at the outset of railway building and before there was any basis of fact and experience upon which to found such generalization, the ultimate principles which long experience has since demonstrated to be sound.

Thus it is seen that the English railways started right, but that they soon got wrong, and for the first 30 years and more, blunders in plenty were made in futile endeavors to construct and operate railways on the principle of inter-competition. Uncounted treasure was wasted in these attempts, and absolutely nothing but experience was gained by it. By 1872 competition had been substantially eliminated through the operation of natural laws and in spite of hostile legislation and litigation. It was said in Parliament, in the debates over the appointment of the Select Committee in 1872, that there was not at that time a single competitive rate existing in the Kingdom. With the legislation of 1873 the general railway situation in England was fixed and determined, and the agitation for competition ended. The railways ceased to be bugbears, and fears of mischief to the public from the growth of railway influence and power gave place to intelligent criticism of railway methods and to a public-spirited determination to get good service at fair rates while giving the companies a free hand to manage their finances in their own way. Thus, after nearly 40 years of experiment, agitation and disturbances, the English people came back about 1872 to their point of commencement. Mr. Adams, in his 'Railroads and Railroad Questions,' says that then England "settled down on the doctrine of *laissez faire*"; and President Hadley, in his 'Railroad Transportation,' says "It might better be said that it has settled down on the policy of specific laws for specific troubles." By about 1872, as we thus see, the problem was solved by the operation of immutable economic laws, and the decision against competition between lines made beyond all possibility of reversion. To make a summary statement it appears that in 1847 there were about 5,000 miles of railway in England, owned and operated by several hundred independent and competing companies; 25 years later there were 13,000 miles of railway, owned and operated by 12 partly competing companies; now there are a little over 15,000 miles, owned and operated by about six non-competing companies.

The history of some of the greater English companies taken a little in detail illustrates the situation. The London & North-Western Railway was first opened for traffic in 1837, about a month after the accession of Queen Victoria. In 1846, it consisted of a main line from London to Birmingham, with some insignificant branches. In 1852, a writer on the position of the company

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complains that it "fell a few years back into the error generally committed by railway companies of amalgamation with numerous other railway companies. From being a line from London to Birmingham, 112½ miles, it has become a line or lines of 539½ miles long—five times its original length." Since that time it has increased its mileage nearly four-fold, and has merged into its system the Chester and Holyhead lines on the west and the Lancashire and Carlisle on the north, besides numerous smaller undertakings too numerous to mention. The Great Western Railway has been absorbing smaller independent lines in its territory for many years, and altogether considerably more than 100 have been so absorbed within the last 40 years. Since 1896 it has taken over about 20 such lines, adding thereby 260 miles to its system. Of its total capital expenditure from 1892 to 1901, amounting to about 15½ millions sterling, nearly 5 millions represented amalgamations. The North-Eastern Railway is a consolidation of various small lines which has resulted in a vast network of railway in the northeast of England without a single intruder in the territory in the shape of a competitor. The report of the Select Committee on Railway Amalgamation in 1872 contained the following reference to this line:

The case of the North-Eastern is a striking illustration. That railway or system of railways is composed of 37 lines, several of which formerly competed with each other. Before their amalgamation they had, generally speaking, high rates and fares, and low dividends. The system is now the most complete monopoly in the United Kingdom; from the Tyne to the Humber with one local exception, it has the county to itself, and it has the lowest fares, and the highest dividend of any large English railway. It has had little or no litigation with other companies. While complaints have been heard from Lancashire and Yorkshire, where there are so-called competing lines, no witness has appeared to complain of the North-Eastern; and the general feeling in the district it serves appears favorable to its management.

The Great Central Railway, which was opened for all classes of traffic in April 1899, has a total mileage of 665 miles. Of this mileage 465 belongs to it and 200 are jointly owned with other companies. In addition, the company owns 111 miles of canals and tramways. It is, therefore, a system essentially made up of joint lines and canals. It is also the newest line in England, and may stand for the most recent type of development in that country.

It now seems certain that in no very long time all intramural transit in London which is wholly or partly underground, aggregating nearly 225 miles in length, will be consolidated into no more than two great substantially non-competing enterprises, dividing the territory in a way between them, upon a line (roughly speaking) which runs northwest and southeast through Piccadilly Circus, or dividing, along non-competitive lines as much as possible, about Piccadilly Circus and converging severally therein. The Joint Parliamentary Committee of 1901 reported that it was desirable that the working of underground railways in and around London should be put under the control of some one consolidated interest; and if we read into the future of these underground lines the railway experience of the past in England above ground, that is sure to be the ultimate solution.

The English courts commenced, about the

middle of the last century, to break down the old common law doctrines theretofore in vogue against monopolies, which were invoked in opposition to railway consolidation. Gradually the whole legal theory upon which those doctrines were attempted to be sustained has been overthrown, until now there is in England no legal objection possible to be urged, and very little popular prejudice to the amalgamation of railway lines whenever and wherever it seems to be economically desirable. The legal arguments against these consolidations were always drawn from the old decisions against monopolies and restraint of trade, which more than 50 years ago began to be repudiated *in toto* by the English judges. Thus in a leading case often referred to, which was decided in the House of Lords about 1850, Lord St. Leonards used the following notable language:

My Lords, there are just a few remarks that I wish to make upon public policy. I will not add a word to what has been already said by my noble and learned friends, but I will call your attention to what fell from one of the learned judges (Mr. Justice Cresswell) as regards the restraint of trade. That learned judge says that with regard to the restraint of trade, there is a maxim in common law, and he refers to a case in Year Books (2 Hen. V., pl. 26), to prove it; but the learned judge did not tell your lordships upon what that maxim was founded. Nobody supposes that there was any statute upon the subject in those times. Upon what, then, was that maxim founded? Why, upon public policy for the good of the realm. It was not good for the realm that men should be prevented from exercising their trades. Now, let us see what this particular case is; it lies in few words and remarkable consequences have resulted from it. It was an obligation with a condition that if a man did not exercise his craft of a dyer, within a certain town, that is, where he carried on his business, for six months, then the obligation was to be void, and it was averred that he had used his art there within the time limited, upon which Mr. Justice Hull, being uncommonly angry at such a violation of all law, said, according to the book, "Per Dieu, if he were here, to prison he should go until he made fine to the king, because he had dared to restrain the liberty of the subject." I wish to draw your lordships' attention to this case. Angry as the learned judge was at that infraction of the law, what has been the result of that very rule without any statute intervening? That the common law, as it is called, has adapted itself, upon grounds of public policy, to a totally different and limited rule that would guide us at this day, and the condition which was then so strongly denounced is just as good a condition now as any that was ever inserted in a contract, because a partial restraint, created in that way, with a particular object, is now perfectly legal. Without any exclamation of the judge, and without any danger of prison, any subject of this realm may sue upon such a condition as Mr. Justice Hull was so very indignant at in that particular case. That shows, therefore, that the rule which the learned judge, whose opinion is now before the House, thought depended upon some rule of common law, regardless of policy, was founded upon public policy, and has been restrained and limited and qualified up to this very hour, and beneficially so, by that very policy which it is supposed had no bearing at all upon the foundation of the rule. (*Egerton v. Earl Brownlow*, 4 H. L. Cas., 1, 237, 238.)

Within the last five years the notable consolidation of the London, Chatham & Dover and the London & South-Eastern lines has been effected, which operates to merge two theretofore independent parallel and competing lines and to allot the whole southeastern section of England to the amalgamated company. This, as is usual in that country, was accomplished through special Parliamentary powers, which in this case were sought and obtained without arousing any great opposition, engendering any considerable heat, or provoking any declamation about a sacrifice of the rights of the public.

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In point of fact, nothing but good seems to have flowed from it.

Previous to 1899 both these railways had achieved an unenviable notoriety for the inadequacy, slowness, and unpunctuality of their services, for the dilapidated condition of their stations and rolling stock, and generally for the backward state of their accommodation. In the case of the Chatham Company the financial position was also precarious, and though the South-Eastern at one time was nominally much stronger in this respect, it too had lost much ground in the preceding five years, and for 1901 its ordinary dividend at the rate of only 2 per cent was the worst in its history. Competition of the worst kind between the South-Eastern and Chatham companies was a normal state of affairs, and as the result both railways spent vast sums of capital and revenue for which there is at the present time little to show except duplicate lines and stations, and inadequate provision for traffic where extended accommodation was most required. Many times a fusion of interests had been urged upon the two companies, but without result. Negotiations for amalgamation were entered upon several times, but they always broke down at the crucial moment.

At last, in 1898, an agreement between the two companies was come to, not for a complete amalgamation, but for the pooling of gross revenue and working expenses and the division of net profits on a fixed percentage basis, with additional arrangements for the joint contribution of capital required. It was not the intention of the two companies to seek Parliamentary authority for this arrangement, as they were not bound to secure the sanction of any other body than their shareholders. But the government virtually intimated that the new arrangement was so important and far-reaching in its bearing on the interests of the public, that the terms of agreement ought to be embodied in a bill. This bill received the royal assent on 1 Aug. 1899, and seven months thereafter the new arrangement came into operation.

The preamble of the bill recites that

With a view to avoiding undue competition and unnecessary expense and delays and other inconveniences arising from diversity of interests and to turning to the best account the respective powers and resources of the two companies . . . it is expedient and will be for the public advantage that, subject to the provisions and enactments in this Act contained, the undertakings of the two companies should be used, worked, managed, maintained, and improved from and after the passing of this Act, as one undertaking . . .

The Act constituted a Managing Committee to administer the two railways as one company, that new body being made up of the directors of the two companies.

The committee of 1872 sum up their view upon the effect of hostile or prohibitory legislation on this subject as follows: "A long and varied experience has fully demonstrated the fact that, while Parliament may hinder and thwart it, it cannot prevent it." The theory of the British Constitution is that Parliament is omnipotent, and here there is formal admission that there are things that omnipotence cannot do.

France.—The French railway system was developed a little later than the English, but we must look as far back as the reign of Louis XI.,

in the latter part of the 15th century, if we are fully to understand and appreciate that development. That sagacious and masterful prince, who reigned from 1461 to 1483, broke effectually the power of the great feudatories, and by a consolidation of authority in the crown laid the foundation of the absolute monarchy. His taking the postal service out of the hands of the feudal authorities and away from the cities and making it a matter of national administration, these 400 years ago and more, was one of the most notable acts of his reign, and was in a way the first step toward the modern railway system of France. "Modern history," says President Hadley, in speaking of the nationalization of the French post-office, "—the history of nations as such—may almost be said to have begun at this point." What Louis XI. did for the power of the crown and for the postal service of the country, Louis XIV. and Colbert did in laying the foundation of the national system of highroads and canals. The *Ecole des Ponts et Chaussées* was founded, and trained engineers graduated therefrom laid out, constructed and perfected that splendid system of canals and highways, radiating from Paris and reaching every corner of the kingdom, which long ago made France the first country in the world in its roads and waterways. There was from the beginning complete organization, intelligent survey and construction and strict supervision; so that an almost perfect system of lines of communication existed in France before railways were known. In no other country had such results been accomplished in road-making, and nowhere else was such completeness of organization and development possible. The genius of highways had in some sort come down to France as an inheritance from Rome, whose military roads were one of her most characteristic monuments. In this state of case, with a perfect system of roads and canals already built and in operation—which made railways seem less necessary in France than in other countries—it is not strange that the French built railways slowly and cautiously. So it was not merely accidental that France moved tardily in this matter. It is not in the French character to make radical changes, or to do things piecemeal; and it was easy for her highway engineers to see that other nations were blundering in their first railway construction. The racial qualities that distinguish the French, their spirit of order and economy, their notion of proportion, and their conservative good sense in business, all had something to do with their making haste slowly in railway building. It is very much the French way to let other people make the initial experiments in new things, and only to take a thing up when it is demonstrably sound and feasible. It is almost a racial instinct, and this is what happened in the development of French railways. The result is that they now possess the only railway system in the world which was intelligently conceived from the outset as a unit, which was scientifically planned and laid down by competent engineers working together to a common end, and which was built as a whole. The conditions in France that made this possible had their genesis in the dominating sagacity and spirit of order of Louis XI. The highways and canals

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led up to the railway lines, and the governmental regulation and control of the old land and waterways grew naturally into the present system of railway supervision. The system of roads and waterways existing in 1830 suited the French nation exactly. They were so arranged and classified that each bore its exact proportion of importance, whether national, departmental or local. They were regulated from Paris with ease and with military precision. Never was there so efficient a corps of engineers for carrying out such a scheme as that which is trained at the *Ecole des Ponts et Chaussées*. The first step taken by the government looking to a general railway system was the appropriation of a sum of money to pay the government engineers for laying out a general system of railway lines covering the whole of France. When this survey was completed, and while the lines existed only on the maps and blue-prints of the engineers, the government next took up the question of ownership and management. While other countries had been acting and experimenting and making costly mistakes, France had been reasoning and thinking the matter out. There was a long series of debates in Parliament between 1837 and 1840. The plan finally adopted was the conception of Thiers, and was settled upon in 1842. The plans then and thus deliberately conceived and matured—both of engineering and of legislation—have since been carried out consistently. They were sufficiently elastic to be practicable. It was at the outset a policy of support and control without actual ownership, or, in other words, a policy of subsidies to encourage private companies, and in return for these subsidies a reservation of more or less important rights of state control. As the work proceeded and as new conditions arose, amendments and modifications were incorporated into the plan as originally conceived. In 1842 it was strictly a plan for subsidies; in 1852, extensions of chartered privileges were granted to the companies; in 1859, a scheme for the guarantee of interest on the bonds was inaugurated, and, in 1883, the government guarantee was extended to dividends.

Under the plan adopted 33 different companies were chartered, contemplating about 2,500 miles of line. Building went on rapidly until the revolution of 1848, and then again after the accession of Napoleon III. in 1851. The lines have from the beginning been laid down with the idea of avoiding all duplication and all waste of capital; they were surveyed and traced by government engineers, and each part stood in its proper and intelligent relation to the whole. Parallel lines were forbidden as a matter of course, and competition was not conceived of as among the possibilities of the situation. By 1852 the number of independent systems had been reduced from 33 to 11, and in 1859 the 11 were reduced to 6, of which 5 radiated from Paris. Each had a monopoly in its own territory. Competition running riot, the construction of needless lines as a mere speculation in the securities, rate wars, with their attendant iniquities, and the consequent wanton waste of money and effort in construction and operation are essentially unthinkable to a French railway engineer or official. New construction is undertaken only as required, and to meet the necessities for more lines growing out of the development of any particular territory. About 1839

it became obvious that a considerable amount of new construction was necessary in order to bring the railway system up to a proper standard of utility and efficiency, and in order to secure this construction, each of the six companies, and each in its own district, undertook to construct a large number of branch lines. The government took the initiative, and in order to facilitate this new work and to secure it promptly recourse was had to a system of state guarantees of interest on the bonds upon which the money for the new construction was to be raised. This was the plan devised by De Franqueville. Money was, of course, easily raised by issues of bonds upon which the government guaranteed 4 per cent, this guarantee making the securities instantly marketable and extremely valuable. There was, accordingly, no wasteful financiering, no iniquitous jobs, no lack of funds, no foreclosures, no reorganizations, receiverships or squeezing of investors. In 1865 a further plan was proposed in the Chamber for the construction of a network of local roads not to belong to the six companies, and the municipal authorities were given the right to subsidize such lines. Pursuant to this plan, several thousand miles of these local lines were built throughout the country within the next five years. It was not, however, contemplated that they should be combined into systems which might interfere in any way with the monopoly of the six companies. They were designed to be feeders. However, after the war of 1871, the prohibition to combine was successfully evaded, and these local lines by a series of combinations began to be serious competitors in many places to the main systems. This made it necessary for the government to take the matter again in hand, and the problem was ultimately solved by having the great companies take over the local lines within their territories severally, upon terms. In 1879, by a decree of July of that year in the Chamber of Deputies, De Freycinet undertook to raise a loan of 3,000,000,000 francs for the construction of about 10,000 miles of additional line. This plan has been slowly carried out since that time. There was at first some delay, but by the beginning of 1884 this last comprehensive scheme of railway development was settled upon, the leading points of which were these: first, that the state hereafter should confine its own railway operations to the small district in the southwest occupied by what is known as the state line; that isolated lines which the state owned in various parts of the country should be taken over by that one of the six great companies in whose territory it lay; second, that additional lines as needed should in future be constructed only by the companies in whose district they belong; third, that the state should guarantee each company a minimum dividend, and that when the amount available for dividends exceeded a certain percentage—the rate differing for each line—two thirds of the excess should go to the state. The limit, however, was placed so high that this provision has been practically inoperative. Thus, for example, on the Northern line, the guarantee minimum dividend is 13.5 per cent, while the point beyond which the state shares the excess is 22.1 per cent. In the case of the Paris, Lyons & Mediterranean, the guarantee minimum is 11 per cent, the state sharing in anything beyond

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15 per cent, and so on, with slightly lower percentages for the other companies.

All of the lines in France with one exception are owned and operated by private companies. They are *concedés* and become state property upon the expiration of the concessions. Meantime they are subject to a strict governmental supervision and control. The length open for traffic on 31 Dec. 1901, was 23,880 miles, which fully meets all the requirements of the country. The original scheme was for the government to contribute about 250,000 francs per mile; and private enterprise to find about 200,000 francs per mile, thus dividing the expense and the ownership. The concessions generally were to fall in, first in about 40 and later on in 99 years. When this occurs—about the middle of the present century—the government will, it is claimed, become possessed of an asset in the shape of railway property sufficient in realizable value to pay off in full the national debt. In 1892 the French railways were conservatively valued at 16,000,000,000 francs. The original plans of construction and joint ownership were somewhat modified as time ran on. In the construction of the French lines there has been less waste of capital and better results for capital than elsewhere in the world. French railways have cost less and come to more than any others on earth. It need not be argued that the French scheme put in practice would inevitably reduce the cost of construction to a minimum and would secure the best results for the least money. Passing by the matter of the state guarantee of interest and dividends, it may be said that the net earnings of the six private companies have been upon an average far beyond anything accomplished elsewhere in the world in that respect from railway operation. Furthermore, in face of the strong position of the French railways as monopolies, the government notwithstanding exercises a sufficient control—one which is in many respects admirable. No other country has in its civil service such a body of trained engineers and inspectors, and nowhere else are things done so well along these lines as in France. The French plan, as is seen, forces the numerous independent companies to work in harmony with one another, while giving each of them an absolute monopoly in their own territory. It renders, therefore, the process of consolidation within that territory easy and inevitable. Whatever slight attempts have been made in the Chamber to check or prevent combination or monopoly have been promptly overruled as contrary to the general scheme. This was particularly the case in 1875, when Phillipart, a Belgium capitalist, undertook to consolidate the local lines as against the six companies; and even the state itself in the operation of its own lines in the southwest has never succeeded in breaking into the monopoly of the Orleans Company in that territory. While France prohibits effectively competition between her railway lines, she is constantly spending large sums in improving internal water communication; and private carriers using these waterways without paying any toll carry off more or less traffic from the railways, and are allowed to do so. To make a summary statement, we find the facts to be that in France the railway system was intelligently planned as a unit from the outset; that the lines were laid down by competent gov-

ernment engineers and constructed without paralleling; that in consequence very little money was wasted in construction; that competition did not enter into the scheme as originally devised, and that when it arose—notably through the consolidations of the network of local lines built between 1865 and 1870—it was suppressed by the government; that railway investments have been almost uniformly profitable, and upon the whole much more profitable than in other countries; that freight rates are not excessive and that passenger rates are very low; that the public is well served, the passenger service especially being of the very best; that governmental regulation is not hampered or thwarted by the strength of the railways as monopolies; that no mischief and much good seems to have come from the elimination of competition between lines, and that upon the whole the French scheme secures a maximum of adequate, efficient and satisfactory service at a minimum of cost and friction.

Belgium.—The policy of government ownership is perhaps best typified by the Belgian system. Of all countries in the world Belgium probably offered the best field for a state railroad. The country is small, compact and rich, the population crowded, active and intelligent, and the industries varied, all which insured a large volume of local traffic. Moreover, Belgium is on the highway between England and Germany, so that, in addition to a dense local traffic, the Belgian lines were certain to secure considerable through traffic on commodities moving between England and Germany. There was in consequence of all this little room for mistake in locating the main lines, and they were, as in France, for the most part laid down intelligently and built economically. Railway construction began as early as 1833. Private companies were allowed to build lines wherever the state did not choose to build, but competition between the lines owned by private companies and the state lines was not at any time part of the original scheme. Like the French, the Belgians saw from the start that competition would be uneconomic and wasteful. The private railways increased rapidly from 200 miles in 1850 to 700 miles in 1860, and 1,400 miles in 1870. This rapid growth of the private lines was accompanied by their inevitable consolidation into systems, and in spite of the fact that competition had not been contemplated, there began in Belgium about 1856 a period of railway war between the state and the private lines and among the private lines themselves. Theoretically, the state had and exercised the power to forbid the private companies from entering into any competition with the state lines, but, in spite of that, competition in Belgium after about 1856-7 was keen. The state had the better routes and in some sort the inside track, but some other advantages possessed by the private companies practically offset this advantage. This competition working the usual mischief finally drove the government to the expedient of buying out the private companies. This began about 1870. By 1874, the government owned more than half the mileage of the country. By 1880, it owned two thirds, and in 1902, there were 2,516 miles of railway in the country, all or practically all, of which is controlled by the state, either through ownership or lease, and

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competition is in consequence wholly eliminated. The state now owns more than 70 per cent of the total mileage, and operates almost all of the remaining 30 per cent by lease. This is in brief the history of the development of railways in Belgium. It appears that competition was not part of the original scheme; that it nevertheless arose and ran its course; that when the state realized the disadvantage of it, steps were taken to eliminate it entirely, and that this was done by the purchase of the competitive lines. There was at first the inevitable consolidation of the private lines, eliminating competition between those lines themselves, but intensifying it as between them and the government lines. Then came the consolidation of these lines with the state-owned lines by government purchase, and competition was at an end. It is another case of the universal tendency to combine, and of the powerlessness of government to prevent it.

Italy.—In 1878, a Parliamentary commission in Italy undertook an investigation of the railway situation in that country. Testimony was taken throughout the kingdom, and an enormous mass of material collected. In 1881, this commission made its report to the government, which was subsequently published in seven quarto volumes. It was the most thorough railway investigation ever undertaken in the world, and the report is probably the most valuable in existence. The material parts of it have been translated into French, and are thus available. From the work of this commission it appears that, prior to the wars which resulted in the union of the Italian states in 1870, the principal railway lines of Italy not only were disconnected and independent of each other, but also constituted isolated or strictly local systems for each of the chief independent states. Thus the lines in Tuscany, in Lombardy, and in Piedmont were wholly distinct both from one another, and also from those centring in Venice, Rome and Naples. Some of the early charters had come from the Emperor of Austria and one from the Pope: the lines were inadequate to the demands of the business of the country, the service was very poor and the companies substantially bankrupt and irresponsible, but there was plenty of competition. The problem after 1870 was to unite and consolidate these scattered and local lines into systems fit for united Italy, to construct new lines, to reconstruct old ones, to re-equip and to reconstitute; and then to operate the reconstructed lines as a whole. The range of mountains from north to south which constitutes the back-bone of the Italian peninsula dictated a natural division of territory for the amalgamated lines. There was as of course much local jealousy to overcome. Although Italy was too poor to spend much money in experiments, there was thought to be danger to the autonomy of the new state in permitting foreign capital to come into the railways, and it was prevented by the government, so that, in consequence of all these matters and hindrances, things at first moved slowly. Connecting links were first built, which served to unite the isolated local systems, the plan being to consolidate the local parallel and competing lines rather than the connecting lines. Finally the roads fell into four systems—that of Upper Italy, that of Rome, that of the east coast, and that of Sicily and the south. Here, as elsewhere in Europe,

competition between parallel lines did not enter into the scheme of construction and reconstruction, and consequently consolidation was not only inevitable but easy, and it was facilitated wherever there was duplication. Upon the division of territory between the four systems, and with the consolidation of lines within those four territories respectively and the building of the connecting links, the problem of construction was in a way to be solved; or, in other words, the lines were laid down and ready for operation. Next came the problem of ultimate ownership and present maintenance and operation. Soon after 1870 the state had begun to buy up the lines, especially in the north, where there was danger from Austrian influence, and by about 1875 a considerable part of the mileage of the kingdom was owned and operated by the state. So that by that time Italy seemed committed to what may be called the Belgian system of state ownership and operation. But Belgium was rich and Italy was poor, and it was soon found that the state was neither managing the lines well nor making any money out of it; there was, therefore, general dissatisfaction throughout the country with the railway system; neither the poorly served public nor the depleted treasury of King Victor Emmanuel was satisfied. It was in that state of affairs that the investigation of 1878 was undertaken, the result of which was that the Italian statesmen who had the matter in hand came to the conclusion that it was not the proper function of the Italian state to run its railways; that state management in Italy had proved more costly and less satisfactory than private management, and that the carrying on of so vast an undertaking by the new state involved political risks and dangers of a serious nature. The outcome was the chartering in 1885 of three private companies, one, the Adriatic, for the territory on the east of the Apennines, a second, the Mediterranean, for the territory on the west, and a third, the Sicilian, for Sicily, the two systems in the peninsula being of about equal consequence, while the one in Sicily was, of course, smaller. A fourth company has since been chartered to operate the lines in Sardinia. These companies were to take over the rolling stock of the lines within their respective territories at a valuation, and thus become the owners of it, and to maintain and operate the lines, dividing the gross receipts with the state on an agreed basis. So that the ultimate solution was that the state was to own the lines, while private companies were to operate them. Practically the railway business of Italy proper is in the hands of two companies, one on either side of the Apennines, the lines meeting at Naples, Rome, Florence, Milan, and elsewhere. Between 1881 and 1897 the length of the Italian railway system almost doubled itself, and in 1898, there were 9,813 miles of line open for traffic. The service is satisfactory and the railway system is making rapid progress throughout the kingdom. Thus we see that in Italy, competition preceded combination; that it was found to work mischief and that attempts at combination were the inevitable result; that when the matter was taken seriously and intelligently in hand by the state, competition was eliminated by law, and the territory divided; and that then, and then only, were satisfactory results secured in railway operation. It appears, therefore, that

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whether we choose state operation as in Belgium or reject it as in Italy, it is the same as far as competition and combination are concerned; that the same economic laws govern in each case, and that in the long run competition is eliminated.

Germany.—Railways in Germany grew up very much as they did in England, at first without any general plan, and without any real comprehension or appreciation of the problems involved. The Germans, however, like the English, seem to have started right on the question of competition. Their earliest statutes explicitly recognized the right to a monopoly in their first lines. The country then consisted, aside from the central kingdom of Prussia, in large part of a number of semi-feudal principalities, and local railway systems sprang up in each of the states, which now constitute the present German Empire, so-called. Prussia followed Belgium in a general way in her early legislation and initial construction. The first state railway in Germany was built in Prussia about 1848-50, from Berlin toward the Russian frontier. Other state lines followed, but, *pari passu*, many private lines were laid down, some of them securing some state aid, by way of guarantees or subsidies or stock subscriptions from the principal states. Some, however, even of the smallest principalities, at first owned their lines outright and operated them too. So there was at the start every sort of a railway in Germany. This haphazard and piecemeal work begot the inevitable result—fierce competition everywhere among the private companies and between them and the state roads. The results were extremely dissatisfactory; the service was poor and the rates high. About 1861, Bismarck came into power, and from that time dates the influence of militarism upon the railway system of Germany. It has since shaped and colored the whole development and operation of the German lines. He saw clearly enough that the mixed and competitive system was a bad one, not only from a military point of view, but also from the point of view of the country at large. Steps were, therefore, gradually taken, in Prussia especially, to acquire the private lines and to consolidate competing and conflicting interests. The matter moved slowly because the country was poor, but the mileage nearly doubled between 1865 and 1875. After the war with France in 1871, more rapid progress was made in unifying the railway system of the country. By 1878, there were about 3,000 miles of state-owned and operated lines, 2,000 miles of privately-owned and state-operated lines, and about 6,000 miles of privately-owned and privately-operated lines. In 1881, the government owned more than 7,000 miles of line, only about 3,000 miles remaining in the hands of private companies. In 1885, the government owned 13,000 miles of line in Prussia alone, while only 1,000 miles remained in private hands. In 1900, there were 30,597 miles of railway in the German Empire, more than 93 per cent of which were owned and operated by the state. Under the present law the government is required to manage the railways "in the interest of general traffic as a single system," and in 1886 the government issued a Code of Railway Regulation, applicable to the whole railway system of the country. Competition practically ceased in Germany by about 1875,

and for the past quarter of a century the railways of the country have been operated on non-competitive lines. Pooling arrangements with the canals and other competing waterways are sanctioned, in order fully to eliminate wasteful competition and unjust discrimination.

Austria.—In 1901, Austria-Hungary had 39,014 kilometres of line open for traffic. The first Austrian charter was granted in 1836, and construction went on actively thereafter until the revolution of 1848. The original idea was to follow the French system, and have the lines built and operated by private companies. Their statute of 1838, it may be noted, was the first general railway law enacted in any country in the world. It provided for undertakings by private companies, and for guarantees by the state of interest upon the cost of construction; it limited dividends on shares to 15 per cent, and absolutely prohibited the construction of parallel lines. It was discovered, however, as time ran on, that the French system was not well suited to the condition of things in Austria; and in spite of statutory prohibition, as the lines were constructed and put into operation, competition ran riot. There was also the usual iniquity growing out of constructing lines for a chance to speculate in the securities; and the competition of the waterways—of the Danube and the canals—although pooling between them and the railways was allowed and encouraged, added to the confusion and disorder of private management. So in 1873, Austria fell into line with the other countries of Europe, and started off in the direction of state ownership and control. In 1885, about three quarters of the mileage in Austria was, however, still in the hands of private companies, but all the lines in Hungary were at that time owned and operated by the state. By 1898, more than half of the Austrian lines were under state management, and the tendency sets more and more in that direction.

Russia.—In May 1900, Russia (including Russia-in-Asia) had 41,400 miles of completed railway, and 8,000 miles under construction, including the great Trans-Siberian line, which is the greatest railway enterprise yet undertaken anywhere. Work began on this line in March 1891, and it is now open for traffic. The estimated cost is about \$500,000,000. The distance all rail from Paris to Port Arthur or Vladivostok is about 7,000 miles, with a through-car service from *la Gare de l'Est* to Port Arthur and Peking. The government furnished a large part of the capital required for construction, and owns and operates about two thirds of the total mileage in European Russia; it has in addition subsidized and thus controls and dominates the policy of the lines owned and operated by private companies. The tendency, as elsewhere in Europe, is toward complete government ownership and operation. There is, therefore, in Russia, it will probably go without saying, no such thing as hurtful competition, and, consequently, none of the evils incident thereto.

The Minor Countries of Europe.—Elsewhere in Europe we find the same variety in railway operation and control as in other things; but the tendency everywhere is to government ownership or to such a strict government regulation as effectually eliminates anything like competition between the lines. Thus in Norway, in 1902, there were reported 1,203 miles of line,

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all now owned and operated by the government; whereas in Sweden, at the end of 1901, there were 7,217 miles of line in operation, of which only 2,392 were government lines. But although in 1893 there were reported to be not less than 108 different owners of private lines in Sweden, the law strictly and successfully prohibits competition between them, or between them and the state lines. The last available figures for the Spanish lines show 8,607 miles open for traffic in that country, all, as in Portugal, owned by private companies, but supported and controlled by the state. In Switzerland, where in 1899 there were 2,396 miles of line in working order, the governmental supervision has until recently been much the same as in Spain. In 1898, by popular vote, it was determined (in view of the evils of over-construction and some hurtful competition in spite of legislative prohibition) to purchase for the government the five chief lines, thus putting Switzerland in the Belgium class of countries owning and operating their railway lines. This scheme is now being financed and carried out by the Swiss government. The railway history of these relatively unimportant European countries is of much less interest and value to us than that of the greater states. The Italian system has been followed substantially in Holland, and in Denmark, and by some of the other minor Scandinavian countries.

India.—The construction of railways in India, which commenced in 1853, has been conducted on three different systems: first, the employment of companies under a system of guarantee; secondly, by the state through its own officials; and thirdly, by assisted companies either with or without guarantee or subsidy from the state, and working with capital wholly raised by themselves or partly with capital provided by the state. Out of eight lines constructed on the first system, five have been purchased by the state. Two of these are worked by companies. The more important, the East Indian line, is carried on by the same company that constructed it in the first instance, on special terms as to the sharing of profits. The second, the South India line, is in the hands of a new company, whose capital was subscribed by the shareholders of the old one. The three remaining lines are worked by the state, and all five come into the category of state lines in the accounts of the government of India. The total number of miles of Indian railway open for traffic on 31 March 1902, was 25,529. Although construction began about the middle of the last century, the system has been developed almost entirely since what English writers on railway problems speak of as "the rise and fall in England of the great fever known as the railway mania," to which detailed reference has hereinbefore been made. The Indian railways were, therefore, planned and constructed in the light of the experience afforded by the home construction and development, and many of the cruder home blunders were thus avoided. They now fall into one or other of four classes: (a) State-owned lines, worked by companies; (b) state-owned and state-operated lines; (c) lines constructed by guaranteed companies, and (d) lines constructed by assisted companies. The English government, following the French led in that respect, provided for a system of guarantees,

by which the necessary funds were cheaply found; in laying down the lines paralleling was avoided, and competition effectively prevented. Where there is no competition there is the less incentive for combination, and there seems not to have been any great tendency in the Indian lines to combine. India, therefore, stands negatively for the soundness of my position. These railways seem to be rather poor affairs; there is much complaint of indifferent service and high rates. How far these things may be chargeable to the inefficiency of the government or may be due to the system itself does not appear. They have up to the end of 1899 involved a yearly loss to the Indian revenues, but the working of the year 1900 resulted for the first time in the history of the Indian Railway system in a net gain to the state of Rs. 87,239, and in 1901 Rs. 1,154,119. From the commencement of railways in India, about half a century ago, to the end of the year 1899, the loss to the Indian revenues amounted to Rs. 57,811,487. Whatever else may be true of the Indian lines, they have been constructed and are operated entirely on the principle of non-competition and division of territory, and there being no competition there has been little tendency to combine; in other words, the evil of competition not existing or not being allowed to exist, there is no call for combination. This is, as I have said, negative evidence in support of the contention that wherever competition is possible combination is inevitable.

Mexico.—The present railway situation in Mexico is fully disclosed in an exceedingly valuable report recently made to the government by Senor Limantour, Secretary of Finance. It purports to have been based upon a careful investigation of the facts, and is on the face of it as intelligent and comprehensive a state paper as any that has emanated in recent years from any government office anywhere in the world upon the subject. The fact that Senor Limantour, who is now virtually prime minister of Mexico, has been nominated by President Diaz as his successor in the presidential office suggests his high standing at home and gives weight abroad to his views on these questions. This report, which seems largely to speak the voice of the secretary himself, deals at length with the problems of competition and combination, and discloses the fact that the policy of the Diaz administration, as now settled and determined, is to meet and solve these problems by absolute government ownership, rather than by any further futile attempts at legislative control. The government, finding that the general railway law of 1898 (from which, when it was passed—as in the case of our original interstate commerce law—great things seem to have been expected) was proving inadequate to the due regulation and administration of the lines, and realizing the necessity of stronger and surer governmental control, has lately come to the policy of going into the open market and of adopting the same tactics as private individuals or companies in purchasing the shares of such lines as it desires to control. Mexico is, therefore, now fully committed to the theory of governmental ownership, if not to that of governmental operation. The government is just now offering to purchase the Vera Cruz & Pacific line, which has just been completed by American capital and lost to its

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original owners by the recent suspension of the Maryland Trust Company of Baltimore. Those portions of Senor Limantour's report which disclose the processes by which the government has acquired and is acquiring such a proportion of the shares of the leading lines as will give it due preponderance in their control are very interesting. The explanations of the causes which have moved the government to this step, as contained in the report, are of an even wider interest and significance to students of the railway problem. In brief, Senor Limantour's explanation is this: The government has until recently been in the usual elementary attitude of encouraging by concessions, subsidies and otherwise all the railways which either citizens or foreigners would undertake to build and operate as private enterprises, in the supposed interest of the most rapid possible development of the country. It was only in 1868 that a general railway law was passed, which, however, soon proved entirely inadequate. It was, therefore, in addition found necessary to prescribe new rules relative to granting concessions for competing lines between points already connected, and to establish a tariff commission—something like our Interstate Commerce Commission—which was an attempt, through the agency of a governmental bureau, to prevent combinations in freight rates, and to regulate them in the public interest. In the light of the experience of other countries—and, as it appears, especially in the light of the experience in the United States—competition between the lines is by this report pronounced harmful, "except where traffic is large enough to support it"—whatever that means. Government ownership and regulation is declared to be the only real preventive or remedy against such disastrous competition—with its inevitable result of the consolidation of competing interests. It is further suggested that the fact that groups of foreign capitalists had undertaken to consolidate several of the principal lines, obliged the government to take a definite attitude lest their great railway properties should thus be taken over and controlled by alien capital. It was clearly seen that these contests for territory between the hitherto conflicting interests would eventually and inevitably result in either the forced or the voluntary consolidation of the competing systems. The law as it stood was inadequate to prevent the acquisition in the open market by any private interest of a control of the shares of any company sought to be acquired, and there was no way to prevent the consolidation of interests through voting trusts or otherwise. Specifically, the situation in the early part of 1902, which seemed to drive the government strongly in the direction of state ownership and control, was this: The railways of the country were found already to be in the hands of no more than four groups of capitalists, namely, the Central, the National (having lately absorbed the International), the Interoceanic and the Mexican—all but the last showing great expansive activity. The Central especially, by the recent purchase of exclusive port concessions and the building of new lines in and out of the City of Mexico, was threatening to cripple the National line. Plainly, therefore, consolidation between it and the Central would inevitably follow in the ordinary course. Meanwhile, through Messrs. Speyer & Co., the National was trying

to acquire the control of the Interoceanic route, but this was frustrated by the government. Various circumstances favored the government as against the foreign bankers in its secret move to secure control of the Interoceanic's debentures. "The ability and high financial standing," says the report, "of the firm representing the interests of the Mexican National constituted a serious obstacle to the attainment of our aims, and it was necessary to act as we did with decision, rapidity and absolute secrecy." A proposition for a common exploitation by the government in association with the National, the International and the Interoceanic companies followed; "but it was soon recognized that such an arrangement could not have the necessary durability nor afford the indispensable conditions whereby the companies might secure themselves definitely against the hostility of other corporations to which they might be exposed in time." The government thereupon, wisely declining to be drawn into any partnership arrangement with the companies, reverted to its original plan, namely, an arrangement such as would give the state primary and absolute control of the three systems, and in such a way as to protect each of them against such future competition as would be sure to arise under the existing state of things. The report declares that the government has now determined to grant no concessions hereafter for competing parallel lines, except in territories where dividends can be earned by each such line. Several voting trusts, in some of which the government has had an interest, have existed in Mexico, but some of these have lately been dissolved upon the advice of American counsel.

It was at first proposed that the government should exercise control of the new consolidated system through the voting trust of the National, already in existence. But, "according to the valued opinion of American attorneys, who are specialists in affairs of this nature, it would have been attended with many objections of a legal character, and have proved a fruitful source of litigation." Accordingly, the consent of its three members was obtained, and the voting trust dissolved, an agreement being entered into with Messrs. Speyer & Co. whereby they were to secure for the government 40 per cent or more of the voting shares. The report then enters into a detailed account of the steps by which this was successfully accomplished, 47¼ per cent of the shares being thus secured. It also goes fully into the question of the probable earnings of the consolidated railways and of the issuance of treasury notes for \$12,500,000, American gold, to pay for them. The advantages to the government, growing out of the control of the new consolidated system, is summarized in the report as follows:

1. The having obtained by one stroke the control of the lines belonging to the National and International without losing control of the Interoceanic.
2. Having secured a considerable reduction in the total cost of the operation; and
3. The ability to effect payments in such manner as in no wise to disturb the equilibrium of the budget, and out of funds which in the long run will be recovered by the state.

Repeated reference is made throughout the report to the railway situation in the United States, and it is obvious that our experience has strongly influenced the Mexican government in

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its new departure in the direction of state ownership. They have learned our lesson before we have learned it ourselves; and now that Mexico has come into line with the rest of the world in its attitude upon the question of railway competition and combination, the United States stands alone among the greater commercial countries of the earth in continued persistence in the futile attempt to secure competition between railway lines and to prevent combination and the consequent division of territory; and it leaves us upon the general questions involved and upon the larger issues of the railway problem, quite alone. From a return prepared by the French Ministry of Public Works, it appears that there were in Mexico in 1870 no more than 349 kilometres of line; that in 1880 there were only 1,120 kilometres, while in 1890 there were 9,713 kilometres, and in 1900 a total of 15,454 kilometres of railway in operation—now, as we have seen, all substantially under government control or presently to pass thereunder, as the result of the investigation and comparison of the advantages of private versus government ownership and operation set forth in Senor Limantour's report.

Australia, etc.—In Australia, state ownership and control has since about 1860 been absolute and universal. The latest available statistics show 12,926.75 miles of line open, namely: In New South Wales (30 June 1902), 3,025.75 miles; in Victoria (30 June 1901), 3,221 miles; in South Australia (30 June 1901), 1,736 miles; in Queensland (30 June 1900), 2,801 miles; and in West Australia, 2,143 miles, by the last report. While there was at first some construction by private companies, every mile is now state railway. In New Zealand, in March 1902 there were reported 2,235 miles of state railway, and 88 miles of private lines. The figures intimate that there is no serious competition there.

South America and Africa.—In South America the governments generally own the lines. In Brazil, in 1897, there were 9,072 miles of line open and 3,500 miles in course of construction. Of this mileage the state actually owns but a small part, but it subsidizes the rest, and thus exercises an efficient control over all, which effectually prevents duplication and competition. In the Argentine there were reported in 1901 about 10,259 miles of road, mostly government lines. Chile in 1902 reported about 3,000 miles open, of which 1,458 belong to the state. The French possessions and dependencies in North Africa reported, in 1900, a railway system amounting to 4,628 kilometres in length, as against 3,595 in 1890, and 517 in 1870; British South Africa seems to have had, in 1900, nearly 6,000 kilometres of lines in operation. There were about 2,000 kilometres of line open in the Transvaal at the commencement of the Boer war, and about 400 kilometres in the Kongo in 1900. The total length of all operated lines in Africa, including the foregoing, the Egyptian lines (2,063 miles), and some little development in Portuguese East Africa, amounted in 1900 to 18,467 miles, substantially all of which is government line. Competition and combination are, therefore, not open questions in Africa. The several European countries that have built the lines there either operate them directly or see to their operation on a strictly non-competitive basis.

Conclusion.—From the foregoing general

view of railway history and development throughout the world, it appears that there is a universal and irresistible tendency in competitive railways in the same territory to combine and to divide the territory between them; that attempts by legislation or litigation to prevent it have uniformly failed; that states which at first recognized and sought to enforce the principle of competition between railways have one after another ultimately abandoned the attempt; that nowhere, except in the United States, is the principle of competition now recognized or still sought to be enforced; that railways in new countries or colonies of old countries, constructed during the last quarter of a century in the light of the experience of the older countries as to competition, have been constructed and operated from the start on non-competitive lines; that the amalgamation of parallel and competing lines is entirely consistent with good service, reasonable rates, and adequate governmental supervision and control; that where railways compete there is always an enormous waste of capital and effort and frequently poor service and high rates; that the tendency everywhere is to eliminate competition where any measure of it still exists; that government ownership is good or bad according to the point of view; that there is a strong tendency in Europe, and elsewhere except here and in England, toward government ownership and operation; that the governments of Europe, with 10 times the police power of our own, have long since abandoned all attempts to hinder and thwart the laws of trade and commerce by restrictive legislation, or to prevent the inevitable in railway development; that, instead of opposing this economic evolution, the most enlightened European governments have on the contrary legalized it, and seek to enforce and regulate it in the public interest; that the best and cheapest service is secured where competition is impossible, and where the state puts the emphasis of its effort, not on interference with railway finance, but on securing good service at fair rates.

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Railway Construction. Tracks.—The railway track more than any other part of the railway machine had a crude beginning, and has reached its present condition of excellence by a continuous series of improvements. In the first series of railroad construction, tracks of numerous designs were built, the chief thought of the builders being to secure a solid structure that would not allow the rails to spread. The track was of necessity relatively heavy and expensive in relation to the weight of the rolling-stock and volume of traffic. Three kinds of rails were used, the one most generally employed consisting of strong wooden beams surfaced with strap iron. The iron rails first used were cast and their length did not exceed $3\frac{1}{2}$ feet. Rolled rails were soon substituted for those of cast-iron and the length was increased to 15 feet, with a weight of about 40 pounds to the yard. As late as 1844 all rolled-iron rails used in the United States were imported from England, and were in the shape of an inverted V. The T-rail now universally employed was not much used during the first 20 years of railroad construction. Since 1870 rolled steel has been used instead of iron, and the weight of the rail has been steadily increased to 110 pounds to the yard. One hundred pounds to the yard has become the standard upon tracks where traffic is heaviest. The standard length of rail has been maintained at 30 feet, but at the present time some track is being laid with rails 60 feet in length. Along with the improvements in the track, bridges and other structures have been strengthened to meet the necessities of modern transportation methods.

Construction.—A perfect and safe track should be complete in all respects; full bolted, full spiked, well ballasted, surfaced, lined, and gauged. The best dirt ballasted track is made, when laying it, by bedding the ties to a level surface on top before putting on the rails. If it is intended to ballast track with cinders, gravel, or stone, as fast as it is laid, the tie bedding should be omitted in order to have the full width of the grade upon which to deposit the ballast, but at the same time the ballasting should be kept well finished up to obviate the danger of spoiling the rails. When laying the rails care should be taken to give the proper space at the joints for expansion. Too much space at the joints must be avoided in order to prevent the car wheels from battering the ends of the rails. The coefficient of expansion for steel is .0000065 of the length for each degree. For a rail 30 feet long and a difference of 100 degrees, or from 10 degrees below zero to 90 degrees, the amount to allow would be one-quarter inch. To take up the flow of the rail one-eighth inch must be added, making a total allowance of three-eighths inch. A steel rail expands or contracts $\frac{1}{800,000}$ of a length under a load of one ton (2,240 pounds) per square inch.

This is also its expansion under a rise of 15 degrees of temperature; consequently, if a 30-foot rail is subjected to a rise or fall of 15 degrees, it exerts a force of one ton per square inch if resisted. Where angle bar splices are used on joints, the best method to hold steel and to keep it from creeping down grades or from running ahead enough to throw the track out of line or kink the rails is to use the slot spikes in the splices. Short rails (less than 10 feet in length) should never be used in making connections except in cases where it is absolutely necessary to use short pieces of rail, as at the end of frogs, in the roundhouse tracks, etc.

Spiking and Gauging.—All tracks should always be kept full spiked and in perfect gauge. Bad gauging detracts from the appearance of an otherwise good track, makes track easier to knock out of line and down below the surface, and is the direct cause of wrecks. The spikes should be driven about $2\frac{1}{2}$ inches from the edge of a track tie. Both inside spikes should be driven on one edge of a tie, and both outside spikes on the other edge in order to prevent the tie slewing and also to assist in holding the rail from creeping.

Drainage.—In order to ditch a cut properly, it is necessary to take measurements from the rail to the bottom of the face of the cut, at different points along the cut, and ascertain at what average distance from the track the back of the ditch should be located. The width of a cut and the slope of its face on each side of the track will govern, to a certain extent, how far from the track rails to place the back of the ditch. The ditch should be deep enough to thoroughly drain the track, and the distance from the rail to the back of it should be in proportion to the depth of the ditch, giving the water an easy fall from the track and full passage through the ditch, avoiding all danger of its washing the shoulder of the grade or undermining the track. As a general rule the bottom of the ditch should be 8 or 10 feet from the rails where the grade width will allow it, and about two feet below the bottom of the ties. When the track is ballasted with dirt, the slope should commence in the centre of the track $2\frac{1}{2}$ inches above the ties, falling at the rate of $1\frac{1}{2}$ inches to the foot. From this point, which is three feet outside the ties, and two inches lower, the incline should be greater, about in the proportion of four inches to the horizontal foot. If the track is ballasted with gravel, the slope toward the back of the ditch should commence about two feet outside the track rails, the ballast at this point being level with the base of the rails. To insure a thoroughly good drainage, all the water which falls upon the track or adjacent land, should be conducted through ditches, culverts, bridges, or other channels to the nearest running stream that will take it away beyond all possibility of injuring the track. Where musk rats or minks are plentiful and cause damage to the track by burrowing under it, a heavy coating of cinders and slag along the sides of the embankment is an effectual protection against their depredations. The cinders form an acid in the water and at the same time are too sharp for the animals to burrow through.

Vitrified Pipe Culverts.—The use of vitrified pipe for culverts under railroads has continued in constantly increasing volume since

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1878, its advantages are now fully appreciated, and experience has pointed out such treatment as will insure the best results in efficiency and permanency. In northern latitudes especially, where severe cold prevails, the culvert should have a good fall, and be so constructed that no standing water be allowed to remain in the pipes and freeze. When drainage capacity greater than that afforded by one pipe is desired, two or more lines of pipe may be laid side by side. This practice is quite common, and gives an important advantage in that the full capacity of the pipes is utilized at a lower depth of water, but the separate lines for pipe should be laid far enough apart to secure a solid bed for each one. No arbitrary rules can be made for work of this character. Varying physical conditions must be met and each particular work treated separately on its merits. Under especially favorable conditions of good soil, light embankment, and good drainage, there is no doubt that the pipe culvert may be put in without cement and without end abutments, insuring complete construction at a minimum cost, but the durability of vitrified pipe being conceded, the permanency of the work is a prime consideration, and the wisest economy would seem in all cases to suggest the use of concrete as a foundation for the pipe, and that each end of the pipe culvert be protected by parapet walls of substantial stone or brick masonry.

Ballasting.—If stone is difficult to obtain, a good track can be made with gravel and stone combined for ballast. The foundation for the track should be laid with broken stone and above it should be placed a quantity of coarse gravel sufficient to bed the ties, surface the track, and dress it. Cinders are equally effective as a ballast, except in wet cuts, when stone should be used, and are cheaper than either stone or gravel. Six inches of cinders will absorb about one inch of rainfall and will thus keep the foundation beneath the ballast dry. They make a superior ballast on clay fills or gumbo bottoms, and are a positive exterminator of weeds. Where the sub-grade is well drained and solid, an excellent track can be made by ballasting with two cars of gravel in a place, and to accomplish the work in this way, estimates may be taken at the rate of 325 cars of gravel to the mile of track. The embankment should not be less than 14 feet wide on top before putting on the gravel. Although *locomotive cinders, furnace slag, burned clay, and gravel* make excellent ballasts, within the past few years the best results have been obtained from stone ballast where the stones are sufficiently small to pass through a 1½-inch ring. The first cost of stone ballast is large; but, once in place and thoroughly tamped, it is extremely solid, will arrest the springing action of the track, and will insure a nearly perfect drainage.

Laying Rails.—Owing to the difference in quality and in the amount of traffic over the rails, it is quite difficult to form a correct estimate of the average life of the same. Good iron rails have been known to last, in service on the main track of a railroad doing a fair business, 9 or 10 years, and steel rails, 15 to 20 years. There is much discussion on the subject of broken or even joints. The majority of track has heretofore been laid with even joints;

but, at the present time, all rails are being laid with broken joints, which consists in placing the rail joint on one side of the track opposite to the centre of the rail on the other side of the track. Outside of the general line and surface, the principal defects in steel rails are pipes, gag marks, and cinders, which result in flaws. Owing to heavy engines and cars of great weight now employed, heavy rails are demanded to be used and as the height gives vertical strength, in such heavy rails used, height should be the main consideration, and should not be less than six inches. To give good wearing heads, the proportion of metal in the head should be kept down to the minimum, as owing to the present process of rolling steel rails at a great heat from a large ingot, a thick head will not give as good results as a thin head rail. The web should be thicker at the base than under the head, which in the high rail insures greater strength, as the tendency is to break at this point, if too weak.

Wave Motion.—As all the rail movements are on the principle of the lever, there is, of necessity, an undulatory motion on the passage of each train, the amount of which being dependent on the condition of the sub-grade, ballast, ties, rail, and weight of the rolling stock. The less substantial the superstructure, the greater ballast compression there will be, and, of necessity, a rough-riding track. The foundation of all ties being loosely compacted material, any movement or "churning" of the tie necessarily throws unequal loading on the ballast at different times, causes its compression and movement, and destruction of the tie foundation. The wider the ties and the lighter the rail and the heavier the loads, the greater such movement must be. Rails take a permanent set, as regards wave motion, in one of three forms: (a) Joint low and centre high. (b) Joint and centre low, quarter high. (c) Entire rail wavy. As the vibratory motion of the rail takes place, something has to give way. If the fastening to the tie is by push bolt or lag screw, the tie will be raised with the vibration and "pump" the ballast, and in time the fastenings will become loose.

Elevation of Curves.—The elevation of curves has been a subject of much discussion. Twenty years ago, one-half inch elevation per degree of curve was considered proper; but now, with faster and heavier trains, a greater elevation is required. Engineers claim that one inch per degree for a speed of 60 miles per hour is proper for curves of three degrees or less, but for each additional degree the elevation should not exceed ¾ inch. While practice teaches the amount of elevation needed in any given case, it is a safer plan to follow the ensuing formula deduced from mechanics in following the theory of elevation; $E = \frac{v^2 g}{32 \cdot 16 R}$, in which E represents the elevation in feet, v^2 the square of the velocity in feet per second, g the gauge or the distance between the points supporting the wheel, or from the centre of one rail head to the centre of the other, and R the radius of the curve in feet. This rule, though scientifically correct, cannot always be applied in actual practice, because all trains do not travel at the same rate of speed. Practical provision

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must be made for the average speed of trains and the number in each class of service. For example, if a road have two trains whose speed is 50 miles per hour, four with a speed of 40, and six or eight with a speed of 25 miles per hour, one inch per degree of curve will be found suitable. The pressure by the fast train against the outer rail of a curve will not be sufficient to spread the rail or throw the track out of line. The elevation will be about right for the 40-mile trains, and while it may be excessive for the slow trains, yet they will do no particular damage to the track and will have a tendency to prevent the track being moved permanently outward by the fast trains. The liability of derailment of locomotives or cars is much greater on a curve track than on a straight track, and a large percentage of such accidents is chargeable to the defects in the rolling stock as well as to the defects in the track itself. Heavily loaded cars often leave the track owing to the failure of a truck to adjust itself to the curve of the track, caused, perhaps, by a defective curve roller, and the greater part of the load resting upon one side of the truck.

Frogs and Switches.—The turnout, by which a car may pass from one track to another, consists of a frog, a rail leading to the frog, a corresponding opposite rail, and a device connecting these rails with the main track known as the *Switch*. If the switch is made to serve two turnouts, it is called a *three-throw switch*; a *trailing switch* is one where a train on the main track passes from frog to switch, while a *facing switch* is one that approaches in the opposite direction. The common or *stub switch* consists of a pair of connected rails so arranged that while one end is fixed, the other can be moved so as to be a part of either the main track or turnout. This switch has two serious defects—the want of safety and the necessary space at the end of the moving rail, which jars the rolling stock, batters the switch rails, and causes discomfort to passengers. The first cost of a point switch is more than a stub, but the split which is more economical to maintain, and safer, is cheaper in the end. In laying switches the general rule is to cut the least number of rails. When putting frogs into a track care should be taken to have them in a true line and level with the track rails which are connected to them. The gauge rail, opposite the frog, should be put to a perfect gauge for the full length of the frog.

The *spring rail frog* has been designed with a view to safety. All four ends are spliced solidly together as in a rigid frog. The hinge rail is attached to the main rail by a bolt hinge. This allows the rail to move freely and prevents it from creeping endwise. It is attached to the movable part of the running rail by strong bolts passing through both rails and a wrought iron filling.

Safety Appliances.—The greatest care must be exercised in the instalment of safety devices, as far as practicable automatic, without discouraging watchfulness on the part of engineers and others. The plan of sealing the stopping mechanism and imposing a severe penalty for breaking the seal is an excellent one. The most carefully planned automatic devices should be provided, and no railroad train, traveling at terrific speed, and representing enormous energy,

should be allowed to run without any safeguard between itself and disaster beyond the watchfulness of one man, who may be taken ill, or suffer from a temporary mental aberration, or may even die suddenly and unnoticed.

Transfer and Turntables.—These important adjuncts should be constructed so as to be conveniently driven by motors with an electric motor; no expense is incurred when the table is idle, and the cost per transfer or turn is much lower than when either steam or hand power is used. Many railroads are putting in electric turntables, and careful investigation shows that the cost per turn by electricity is from 30 to 50 mills, while with hand power it is from 10 to 12 cents.

REQUIREMENTS FOR ONE MILE OF TRACK									
No. ties per 30' rail	No. ties per mile	No. tie plates per mile	4 spikes to tie		6 spikes to tie		Length of rail	No. rails per mile	No. spikes per mile
			No. spikes	No. kegs	No. spikes	No. kegs			
15	2,640	5,280	10,560	28	15,840	42	20'	528	1,056
16	2,816	5,632	11,264	30	16,896	45	22'	480	960
17	2,992	5,984	11,968	32	17,952	48	24'	440	880
18	3,168	6,336	12,672	34	19,008	51	26'	407	814
19	3,344	6,688	13,376	36	20,064	54	28'	378	756
20	3,520	7,040	14,080	38	21,120	57	30'	352	704
							33'	320	640
							60'	176	352
									No. bolts per mile
									4 hole splice
									Bolts
									2,112
									6 hole splice
									Bolts
									3,168
									Pence posts
									Ft. apart
									No. one side
									8'
									660
									12'
									440
									14'
									377
									16'
									330
									16 1/4'
									320
									18'
									293
									1,920
									1,056

Drawbridges and Liftbridges.—Electricity has a specially valuable field in connection with the operation of drawbridges and liftbridges. Speed and control are the requisites of modern methods, and the old plan of operating a drawbridge by a capstan worked by several men is now practically obsolete. A few years ago, the drawbridge at Hamilton avenue over the Gowanus Canal in Brooklyn, N. Y., was operated by from three to five men working on a capstan. Then

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it took four or five minutes to complete the operation. The electric motor which has been substituted opens and closes the bridge in 50 seconds, and the services of but one man are needed. When electric current can be obtained, practically all drawbridges now designed are constructed to operate by electric motors.

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Railway Construction, Street. See STREET RAILWAY CONSTRUCTION.

Railway Economics. In one sense railway economy is only a branch of the general subject of political economy (q.v.). The laws which govern railway rates, railway profits, or railway control are fundamentally the same as those which govern the rates, profits, or control of any other kind of industrial enterprise. But among all our important industries the railway is the one which has most quickly and completely felt the effect of modern methods in the handling of capital. For this reason it is useful to make railway economy a subject of special study, because it indicates the possibilities and difficulties which lie before our statesmen in the future, as distinct from those which they have habitually met in the past.

The feature which distinguishes modern industries from those of earlier times is the large investment of fixed capital. Two or three centuries ago we had unimproved farms, small stores and shops, rude boats and wagons. To-day we have highly developed systems of cultivation, large stores and factories, and complex means of carriage by land and water. But nowhere has the change been so marked as in the character of the highways on which commerce is handled. The rough road of ancient days has given place to the turnpike, the turnpike to the canal, the canal to the railway; and with each successive generation the railway itself has become an instrument of increased size and strength.

The effect of all this change has been greatly to reduce the cost of transportation. But this result has not been reached in any simple manner. One set of elements in the cost—the so-called *fixed* charges on capital—has been enormously increased. The country road of our great-grandfathers may have cost from \$300 to \$500 a mile. The turnpike road cost ten times as much—perhaps from \$3,000 to \$5,000. The old-fashioned railway, conforming itself closely to the original character of the ground, with steep grades and sharp curves, could be built for \$30,000 a mile. The modern trunk line, where grades are reduced to a minimum and every engineering appliance is most highly developed, costs \$100,000, \$200,000, or in some parts even \$300,000 a mile. And yet it is the expensive appliance which does the work cheaply.

The general explanation of this paradox is simple enough. The higher the fixed charges per mile of road, the lower is the expense of carriage for each ton of traffic. The old-fashioned road cost perhaps \$25 per mile per year for interest and maintenance; but the expense of hauling a ton over a mile of such a road will run at least as high as ten cents. The turnpike costs perhaps \$300 a year for interest and maintenance, but the expense of hauling a ton over a mile of turnpike will be less than

a third of what it was over the old-fashioned road; because horses on a good road can draw three times as heavy loads as they can on a bad one, with less wear and tear to the wagons and to themselves. The interest and maintenance charges for a poorly located railway may be \$2,500 per year, more or less. The direct cost of hauling each ton over a mile of such road will be in the neighborhood of one cent. Increase the excellence of the location and construction of your railway, and the annual interest and maintenance charges will increase to \$5,000, \$10,000, or even \$20,000 a mile; but the possible train loads will increase so rapidly as the grades and appliances become better that the cost of hauling each ton will be reduced to half a cent, a quarter of a cent, or in some instances an eighth of a cent a mile.

The question which of these methods is the most economical depends upon the amount of traffic which you have to handle. If there are only a thousand tons of traffic in a year, it will not pay even to build a turnpike. For the saving of \$70 which results from the ability to haul those 1,000 tons at three cents instead of ten cents will not pay the \$300 a year interest and maintenance on a mile of turnpike. But if we are to carry 10,000 tons instead of 1,000 there is a saving of \$700 instead of \$70, and this makes the better road the more economical. If we can get \$100,000 it becomes profitable to have a railway; and if we can get 1,000,000 it will pay to have that railway constructed with a very high degree of excellence. The more traffic there is, the more does economy in the direct cost of hauling count as a justification for an increase of fixed charges.

In a newly settled or slightly civilized community the possible traffic per mile is small, and the appliances must be correspondingly rude. Economy of fixed charges is of more consequence than economy of operation. But as time goes on these conditions are reversed. Increase of population means increased demand for traveling accommodation. Improvement in the arts means increased production, increased amount of freight to be carried to market and, what is perhaps of still more consequence, increased demand for the hauling of coal and raw materials and of food supplies for the laborers. Under all these circumstances there has been a demand for every invention which would enable a railway by an increase of original cost to do its work more economically. We have substituted steel rails for iron because they enabled us to carry heavier loads. We have for the same reason gradually increased the weight of our cars and our engines. The modern locomotive weighs more than the old-fashioned locomotive and burns a little more coal; but it hauls five and ten times heavier loads of freight.

Occasionally it will happen that railways are built or improvements introduced in advance of the needs of the country, where population is not sufficiently dense or productivity sufficiently high to support them. This was notably the case in the years preceding the crisis of 1857, and again in the years immediately subsequent to the Civil War. In both of these cases the traffic was insufficient to support the lines that had been built in the newer territories, and very serious loss neces-

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sarily resulted. But the general effect of railway development has been to create an enormous traffic at low rates, in place of the very much smaller traffic which was possible at the rates that prevailed before the railway was introduced or improved.

To this extent the effect of new methods of railway economy has been thoroughly good. But the good thus done has been accompanied by certain evils, which at times have proved very serious. The direct expense of doing each piece of business—of loading or hauling each ton of freight or carrying each individual passenger, which the railway agent must charge against every such piece of traffic—becomes very small in proportion to that contribution to the fixed charges of the road which there is no available rule for apportioning. These enormous fixed charges must be met somehow. But how much of them should be paid by passenger traffic or how much by freight traffic, how much by small quantities of valuable goods carried at high rates and how much by large quantities of cheap goods which will barely pay more than the direct expense, is a matter for the agents and managers to decide in their discretion. A railway rate really consists of two parts. It is a price for the loading or hauling, plus a tax for the general expenses of the road. The price element must be based on the cost of doing the work. The tax is usually based upon the ability of the goods to stand its imposition—or, in the current language of the market, upon what the traffic will bear. Manufactured articles will bear a rate per ton which would be simply prohibitory if applied to coal or ore. Therefore freight is classified; and instead of a uniform rate per ton we have several different sets of rates for goods of different classes. Short distance traffic will bear a rate per mile which would be prohibitory to long distance traffic. Therefore we make reductions in the rate per mile for long distances which would be ruinous if applied to short distances. Of course the element of economy of handling enters into these classifications and distance gradations; the low grade goods are on the whole cheaper to handle than the high grade goods, the long distance traffic is more economical than the short distance traffic; but the element of ability to pay the tax is the one which is of more consequence than all others put together.

But it is obvious that this taxing power is a very dangerous thing to place in the hands of private corporations, and one which is liable to be abused. To meet this danger and these abuses several remedies have been proposed.

1. *Competition between Different Carriers on the Same Line.*—This was the theory upon which the early railway legislation of England was based. It was supposed that a railway corporation would, like a turnpike or canal company, be primarily occupied with furnishing the highway; and that any carrier who should choose to build cars or locomotives could run his trains on the railway, precisely as he might run his wagons on a turnpike or his boats on a canal. It was impossible to apply this principle, partly on account of difficulties of operation—the danger of accident being very great if independent carriers tried to use the same line—but chiefly because a railway could handle

its own cars and trains with advantages so much better than those which could be commanded by the cars and trains of independent carriers that the latter could not afford to pay the tolls fixed by charter.

2. *Competition between Different Lines.*—

This was the theory which was at first favored in the United States. It was a little more workable than the English theory; but it can hardly be said to have produced better results. For if you have parallel railways, so that each producer has the choice of two lines, this duplication of plant involves a great waste and loss to the community; moreover, the competition between two such parallel lines often becomes so ruinous that it is followed by their consolidation. If, on the other hand, we have competition at some points and not at others, the places which get the benefit of the competition enjoy very much lower rates than those which prevail elsewhere, and we thus have discrimination, generally in favor of the large cities and often in the form of secret rebates in favor of the more unscrupulous shippers in those cities, which are an evil of very great magnitude. They tend to increase the drift, already too strong, from the country to the city; they also tend to substitute a system of underhanded dealings in business for an open and straightforward competition between producers on equal terms.

3. *State Regulation of Rates and Fares.*—

This system takes two forms, according as this special liability to regulation does or does not carry with it the grant of monopoly privileges. In America, during our later period of railway legislation, we have tried to have such regulation without legalized monopoly. In France the two have been combined.

The danger in the American system of rate regulation, without the guarantee of special rights and privileges, is that the rates may be fixed so low that there is no profit in the business of railway carriage. Under such circumstances railway building will be stopped and the community will be deprived of the necessary development of its facilities. This was felt at the time of the Granger legislation in 1874. It was also felt, though to a somewhat less degree, in the years succeeding the passage of the Interstate Commerce Act. The community attempted to secure low rates without giving railway owners any corresponding consideration. The effect was that it got fewer roads than it wanted until the laws were changed or until population had growth to adapt itself to the new conditions.

A second danger in the American system is that a legislature which regards itself as the representative of the shippers' interests as against those of the railways will be always trying to stimulate spasmodic competition, as was done in the anti-pooling clause of the Interstate Commerce Act, and will tend to perpetuate those very discriminations or differences in charge which it is the main object of railway regulation to check. For it has been proved over and over again that if you have really active competition between agents of competing lines you do not secure that openness and equality of rates which is possible when such competition is abolished.

The French system of rate regulation is different from the American. By French law

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the whole country is divided into districts. Each railway has a monopoly in its own district, in return for which monopoly and for certain substantial subsidies given by the government the company is subject to certain well defined rights of control. The French system seems equitable in theory, but it cannot be said to have worked well in practice. For the agents of a railway company which holds a guaranteed monopoly have such an advantage in bargaining with the government that they find it possible to exact very large compensation for any concessions that they make to public demands. They get a great deal of profit in return for very little control.

4. Direct Ownership and Operation by the Government.—This is the system which has prevailed in Germany, especially during the last quarter of a century. Prior to that time Prussia and other continental countries had contented themselves with owning parts of their railway system, leaving other parts to be built and operated by private enterprise. The effect of this mixed system was that the state railways became virtually one private corporation among many. The companies dictated the policy of the government, instead of giving the government any opportunity to control the policy of the companies. To avoid this evil the Prussian government purchased substantially all of the railways of that country, and many other states have tried to follow the example of Prussia to the extent of their financial ability.

The excellence of a government railway system will, roughly speaking, depend upon the excellence of the government itself. If the administration is in financial straits the ownership of a railway system furnishes a temptation to tax the people which is too near at hand to be resisted. If, on the other hand, the government is in a sound position financially, it will adopt a much more liberal policy in the matter of charges. Such a government will probably try to meet popular demands more fully than some of our private corporations. But it is slower in perceiving commercial needs and wants, and hence will not respond as promptly to business necessities and to business opportunities.

There was a time when people discussed the merits of state and private ownership of railways as a question of theory, some being heated partisans of the one system and others equally hot partisans of the other. That time is now past. It is universally recognized among experts that a well managed state road and a well managed private road will adopt nearly the same policy. A large private railway system cannot permanently try to get very much more than a fair rate on its investment. A state railway system cannot, in justice to the taxpayers, afford to get very much less. For state roads have cost money which has been borrowed. The interest on the bonds must be paid, and these interest payments are usually quite as large as the dividends of countries which have private railways. Again, well managed state railways must adopt substantially the same principles of classification and distance gradation as private roads, because it has been proved that only by the adoption of these principles can the railways do the maximum service to the community at the lowest average rates. The chief difference between state railways and private railways

is not in what they can do if they are well managed, but in the particular directions in which they are likely to err if badly managed. With private roads these errors will take the form of fraudulent issue of securities in connection with their capital and of favors to large concerns in their operation. With state roads they will take the form of wasteful and ill-judged expenditures for building and of lack of readiness to take advantage of new methods of operation. It is a somewhat interesting fact that if we take similar roads in different countries the inflation of the capital account due to water in stock of private corporations is just about balanced by the waste due to ineffectiveness of government contract work for public ones.

Though the abuses are different, the remedies are nearly the same in the two cases. Whether a road be operated by a private corporation or a public one, the first desideratum for good management is publicity in all its affairs—straightforward and simple accounting, open bidding with regard to contracts, adherence to the published rate sheets, promotion by merit and not by favor. If to this publicity of method is added responsibility to an independent judiciary, we attain a really salutary system of railway control, whatever the form of ownership or operation. It will be impossible for any railway managed under such a system to make its rates much higher than the rates of other parts of the same country, or even of other countries under similar conditions; because producers of different countries are competing in common markets. If Russian producers and American producers are competing in Liverpool, the charge from the Mississippi River to Liverpool influences the general schedule of transportation rates from the Volga to Liverpool, and *vice versa*. If we can secure fair treatment as between individual shippers, we can usually let the general schedule of rates take care of itself. We can let the agent adopt the system of charging what the traffic will bear if we insist that he does not make this an excuse for charging the individual what his traffic will not bear. For with a system of publicity of rates and responsibility of agents, it will be so obviously disadvantageous to the traffic of a railway itself to have an unreasonably high schedule of charges that enlightened self-interest will dictate the adoption of a tax system which will be more concerned to develop traffic, whether of freight or passengers, than to impose an unnecessary burden upon it.

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Railway (Electric) Economics. No single industry or art has probably ever, within an equal period of time, brought about as great changes in the activities of municipal life as has been the result of the development of the electric railway since 1890. Until about 1900 the development has been essentially that of street surface railways, operating on tracks laid in the street of centres of population, or upon public highways. On account of the use of the highways simultaneously by other forms of traffic, the schedule speed of railways where tracks occupy public highways is necessarily relatively slow (between 9 and 15 miles per hour). It is this speed limitation which has been the cause of the halt in the extension of electric railways, built upon

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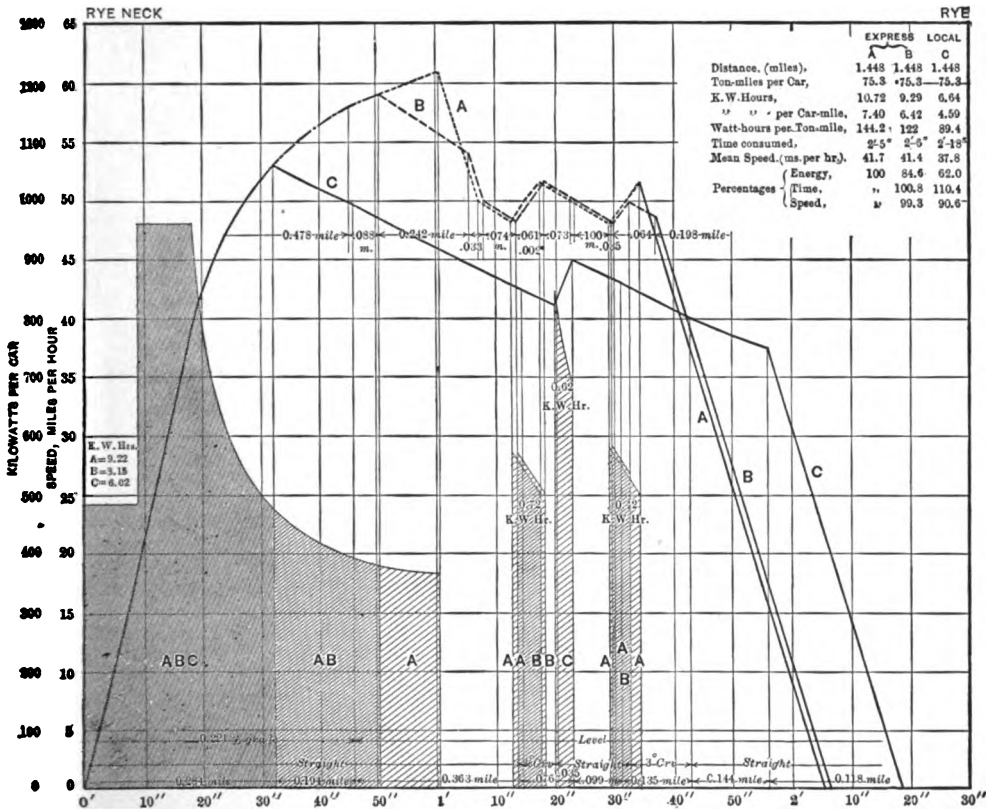
public highways, into the suburbs. At first, too much was expected of these railways, with the result that population centres sprang up at points considerably distant from the cities. The incentives for this migration from the cities were the lower rents, lower cost of living, and, in general, better sanitary conditions of the outlying districts. Of recent years, there has been a very considerable return of the outlying populations to the cities, necessitated by the considerable and prohibitive time interval involved in passing between the suburban homes and the places of business, in the use of the existing suburban electric railways. Generally speaking, the suburban service of steam railroads has not supplied the

known causes, is making imperative the population of the outlying districts, which can only occur with the advent and development of adequate methods of transportation.

Since 1900 the development of high-speed electric railways has been progressing with marvelous rapidity. The best of these newcomers adopt the highest class of steam railway practice in the construction of their permanent way. The essential characteristics of the coming interurban electric railways must be: (1) Safety to the public; (2) high schedule speed; (3) reliability of operation; (4) minimum cost of operation and maintenance.

None of the foregoing conditions can be satis-

PLATE I.



Actual comparative run curves showing economic results of different schedule speeds. Compare tabular data at right of sheet.

existing want, on account of high fares, timetable limitations, and other aggravations.

The time has come when distance, especially in and about large population centres, is measured essentially and only by the time consumed. A man no longer lives 20 miles or 30 or 40 miles from his office, but he lives 30 minutes or 40 minutes, or one hour distant from his office. In other words, the time has come when the space interval, or distance, between two points or localities, such as two cities or towns, or the home and the office, has resolved itself entirely into a question of time consumed in passing from one point to the other, rather than any question of distance covered. Again, the constantly increasing costs of living in the large cities, due to well-

factorily attained where the cars are operated upon or along public highways upon which pedestrian and vehicular traffic also exists.

Individual or private rights of way are the solution of the problem. The private right of way, however, should be an *individual* roadway throughout, that is, it should be free from grade crossings of all kinds, except at such special points and places where the cars run onto other tracks over which they are to operate.

Interurban roads, to be successful, must be capable of making high speeds, safely and continuously, and this cannot be accomplished where the roadway occupies the public highway or crosses intersecting highways at grade.

Furthermore, when a railway owns its right

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of way it is once and for all exempt from the demands, and continuously increasing impositions of public officials in the matter of annual payments to the local authorities as "compensation" for the use of the highways and of repairs to the space between its outside rails, and for various and constantly increasing distances beyond the outside rails. In such matters it has become the practice of some public officials to impose additional burdens every time a given railroad seeks any additional or other privileges in the matter of extensions, track facilities, etc.

In several existing cases interurban lines have been laid on public highways for considerable distances, when they could have purchased rights of way parallel to the highways upon which they have laid their rails, and but a few hundred feet from such highways, for merely nominal sums ranging between \$1,200 to \$2,000 a mile. For a road 30 miles in length, a private right of way costing as much as \$3,000 per mile will increase the cost but \$90,000 for the right of way and (allowing the maximum of three crossings per mile at an average cost of \$5,000 each) about \$150,000 for the crossings, or a total of \$240,000. At 5 per cent the interest on this cost is but \$12,000 per annum. As the items of operation and maintenance must be less for the road using a private right of way, they can safely be left out.

Consider the relative marked advantages which a private right of way 200 to 500 feet from the main road would secure. In the first place a schedule speed three or four times as great could safely be made, and as relatively high speeds and large daily car mileage per car are necessary to secure the best commercial results, for long haul business, this is all-important. In the second place the railway would be free from the petty annoyances, impositions, and demands of ignorant, unjust, or corrupt local authorities. In the third place its property must become more valuable each year as the adjoining territory builds up and settles, and within a comparatively short time it will probably have a railway through a thickly settled community, upon its own property or right of way, subject to no annoyances, impositions, or charges, except the universal and open real estate tax. In the fourth place it will be in a position to so manipulate and increase its schedules as to enable it to "get all there is out of the territory," and it can also arrange for and take care of any passenger or freight business of any existing or future connecting road or roads. In the case assumed in the preceding paragraph, the additional annual fixed charge for these advantages is \$12,000, plus the annual real estate tax against which must be placed, for the care of a good road upon a public highway, the interest on the first cost of paving between the rails and for the required distance outside of the rails, plus the annual cost of maintaining the roadway as demanded by the local authorities to facilitate vehicular traffic, and it should not be forgotten that the cost of maintaining any roadway subject to vehicular traffic is always in excess of maintenance costs where vehicular traffic does not occur on the railway roadway. Consequently for the case of a railway whose tracks are upon a public highway we have two additional costs which are: (1) That of maintaining a paved or macadamized roadway for vehicular traffic. (2) That extra cost of maintaining a roadway, such as cost of

surfacing, alignment, etc., due to the additional use of the roadway by all kinds of vehicles. To the foregoing debits against the tracks upon public highways must generally be added the annual payment exacted for the use of the highway known as "compensation." In several instances which I have investigated the two accounts were about equal, leaving no doubt as to which scheme to adopt, as in the one case the company would have nothing for its money, while in the other it would have had a real estate asset which would constantly increase in value. In addition there would be eliminated the uncertain, constantly increasing, and constantly more serious claims on account of accidents, due to collisions, etc., on account of the development of the territory and the constantly increasing use of the railroad by the public together with consequent greater use of the highways by the public.

The foregoing has reference especially to the physical details of the permanent way of the highest type of the coming high speed electric railroads which will play such an important part, not only in the imminent necessary readjustment and distribution of congested populations, but in the future economic processes and development as well. At present and for a while the coming high-speed general traffic, interurban and suburban electric railways will be, in most cases, passenger transportation enterprises. That such systems are, however, destined to be important factors in the transportation of goods and merchandise admits of no doubt whatever.

The freight and express traffic of existing interurban electric roads has been shown by the experience of the interurban lines in the United States and elsewhere, to be a profitable portion of their business and one which bids fair to develop enormously. It is difficult yet to obtain any satisfactory figures as to just what this business will amount to, but from the information available from the roads investigated, a fair present average on a good road shows that it is now from \$500 to \$1,000 per annum per mile of single track, depending upon local conditions and the extent to which the freight and express business has been sought and developed. There is no doubt but that the same reason which has developed the passenger business on electric lines, that is, short headway, will be and is a large factor in developing the freight and express business. With steam railways the object is to make every freight train unit a self-supporting or paying unit, which is also, as is well known, the process sought to be followed by steam roads in their passenger business. Steam railway operating economy now lies in the direction of long trains, or in other words, in long headways, and the tendency of modern steam railway economy is toward building larger and heavier freight engines, and cutting down grades and eliminating curves so as to reduce the cost of the "ton-mile," etc.

In the case of electric roads the unit at present is not the ton-mile, but the car-mile, and there is practically no economy to be gained by running long trains. It has been demonstrated that passengers can be profitably carried for less per mile on interurban roads paralleling steam roads than the steam roads have been able to carry such passengers for. This condition is due to the fact that electric roads operate single cars or trains at frequent intervals, and increase the

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"riding habit." The same law holds good in freight transportation. If the commercial interests of a community realized that they could replenish their stocks upon a day's notice, they would cease laying in supplies of goods of such quantity that would last them a week or ten days, or possibly two weeks, as is now the case, and through the saving thus secured in insurance, interest, warehouse handling, etc., could afford and would pay a higher rate to the electric road for the "express" handling of goods than that now paid to steam railway companies. In other words, a rapid and frequent train service, such as electric roads can give, will not only materially increase the freight and express business, but by eliminating the economically non-productive conditions now existing between the producers and the consumers will develop a most important landmark in political economy.

It is an unfortunate fact that engineers and others who have had to do with heavy duty and high-speed electric traction enterprises have not at all appreciated the economic relations maintaining between various relatively high schedule speeds and the costs of establishing and maintaining such schedules. The proof of this ignorance of the costs of high schedule speeds is to be found in the numerous general specifications for high speed electric railways wherein are to be found the provision that:

The schedule speed of the train units shall be miles per hour, allowing seconds for stops at stations, averaging miles apart.

While it is true that high-speed railways are now economic imperatives in and around large commercial centres of population, it should never be forgotten that very high schedule speeds with frequent stops are expensive, and, therefore, only warranted in special cases. The schedule speed

and therefrom a set of approximate conditions selected upon which to base the determination of an accurate set of speed-time and energy curves in the construction of which is considered and represented and determined the influence of all the details of alignment, gradients, and stops of the line as surveyed.

Two or three *actual* and *accurate* total run sheets, for runs in both directions between termini, should be constructed before attempting to arrive at a conclusion as to the most economic schedule to adopt. Plates I, II, and III show examples of sections of actual total runs or individual runs, between two stations, of such accurate determinations, made in connection with the development of the engineering details of the New York & Port Chester Railroad. Such curves also give valuable information relating to the proper gearing of any given equipment for the work it will be called upon to do. Generally speaking, it will be found that motors should be geared for the lowest maximum speed, allowing a fair margin for occasional required increases due to the necessity of making up lost time, for the making of the required schedule. A gear ratio giving an unnecessarily high speed not only overheats the motors, but produces unnecessarily great demands upon the transmission system and the generating and sub-stations.

In determining upon a schedule, not only must the matter of motor heating be considered as affected by different rates of acceleration, but there must also be considered and determined the matters of the line fluctuations together with those of energy, input and station loads. While rapid accelerations effect marked energy savings, it is entirely possible to wipe out any advantage so obtained on account of the poorer boiler, engine, and generator economies due to irregular load curves and low power factors.

TABLE I.

Distance between stops		Watt hours per ton mile for schedule speeds of					
Miles	Feet	40 miles per hr.	35 miles per hr.	30 miles per hr.	25 miles per hr.	20 miles per hr.	15 miles per hr.
3	15,840	110	80	78	65	53	40
2½	13,200	121	90	83	74	54	40
2	10,560	142	99	86	80	60	41
1½	7,920	....	123	95	85	68	43
1	5,280	....	....	128	90	74	50
¾	2,640	....	....	....	145	119	56
½	1,320	....	....	....	....	....	120
Train friction in pounds per ton		35	30	27.5	25	20	15

affects not only the cost of the motor equipment, but also that of the main generating station, transmission system, and other details. For this reason the matter of the proper schedule speed should always be carefully and exhaustively investigated and determined before it is announced. The scientific method of procedure consists in first making a rough preliminary determination by assuming the line to be straight and level and the stations or stops at equal distances apart. By assuming certain safe and practically standard data, such as tractive effort, braking effort, time of stops, and train friction, and having the distance between stations, a set of roughly approximated speed time, distance time, and energy curves, can be calculated and therefrom approximations obtained of the energy which will be required to maintain various resulting schedules,

The braking effort or retardation is taken at 150 pounds per ton.

The stops are taken at 15 seconds each, except in the case of the 15-mile per hour schedule, where 10 seconds is taken.

The foregoing figures are for cases of approximately level and approximately straight roads.

For a schedule of 40 miles per hour the speed attained will be between 60 and 65 miles per hour. A schedule of 25 miles will require speeds of from 40 to 50 miles per hour, etc.

The rate of acceleration for the long runs varies from 75 to 110 pounds per ton, going as high as 210 pounds per ton for short runs.

The foregoing applies to single car units. If units of more than one car be used, the friction in pounds per ton will decrease and with it will also decrease the energy consumption in watt hours per ton mile.

Some of the places have been left blank on account of the impracticability, with existing apparatus, of making some of the high schedules with the short distances between stops assumed in the table.

The figures are for the energy required at the motors.

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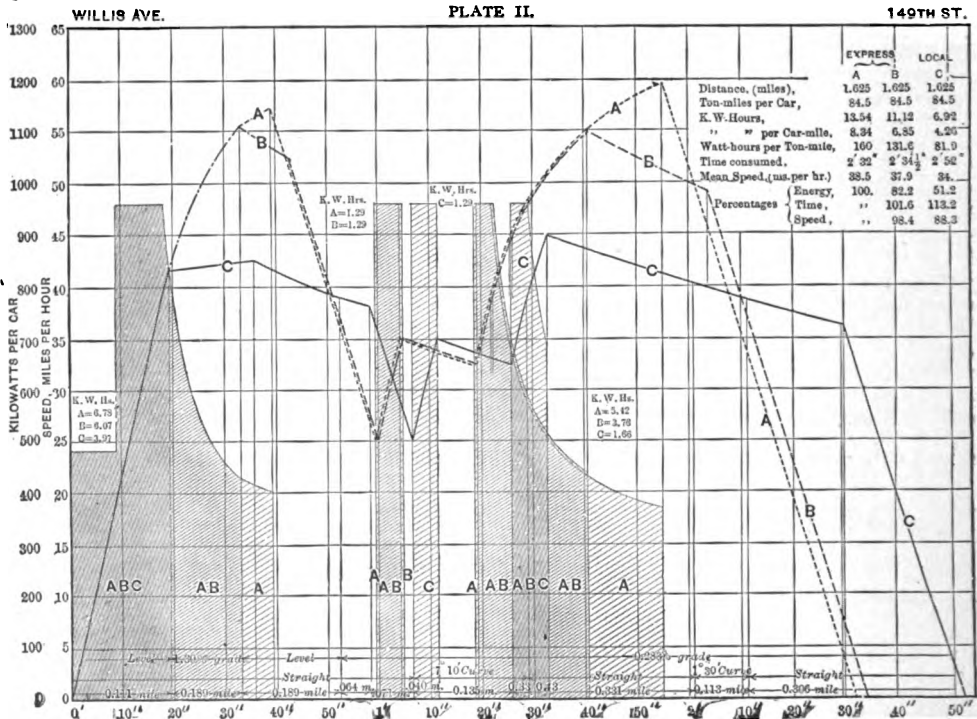
Table I shows, strikingly, the relations existing between schedule speed, stops per mile, and corresponding energy consumption. In the face of the conditions shown in the table it is difficult to imagine why the matter of schedule speeds has been handled so recklessly by engineers and promoters inaugurating new enterprises.

In view of the rapidly increasing maximum speeds at which interurban systems are being operated, attention must also be paid to those details of design which will reduce the train resistance and more especially that element thereof known as "wind resistance," which is by far the greatest component of train resistance. Smooth, flat sides with the platform ends rounded or tapered and enclosed are among the simple and effective methods of car construction employed. It is astonishing what a saving in

than 55 such formulæ. A complete list would doubtless include twice that number. These formulæ differ greatly in their form and in the purpose for which they are intended. In some cases, the formula is intended to give the total resistance, including that of the locomotive and the cars constituting the train. In other cases the formula gives only the resistance of the train. In some cases the formula takes into account only the velocity of the train; in other cases the formula takes into account the number of cars, and the weight and the length of the cars in the train.

It is apparent that the matter of schedule speeds, as related to costs of operation, is not generally understood.

The schedule speed may be a large factor in determining the commercial success or failure of



'Actual comparative run curves showing economic results of different schedule speeds. Compare table at right.

watt-hours per ton mile or per car mile and consequently, in cost of operation, the application of the simple methods above suggested will produce as indicated by recent tests.

The problem of determining the total amount of mechanical resistance opposed to the motion of a car or train is a very difficult one, for which it may be said, in fact, that no general solution applicable to all cases has thus far been found. It has been generally admitted, for a long time, that this resistance, to which the general term "train resistance" has been applied, varies with the speed of a car or train; but there is a wide difference of opinion in regard to the amount of variation to be expected at different speeds. Many "formulæ" for calculating the train resistance as a function of the speed have been proposed and used. J. A. F. Aspinall, in his paper on 'Train Resistance,' read before the Institution of Civil Engineers, in 1901, tabulated no less

an enterprise. As an illustration see Table I) we see that the watt-hours per ton-mile, allowing a stop every two miles, required for a 40-mile per hour schedule, are 142, while for a 35-mile per hour schedule there are required about 99 watt-hours per ton-mile. We assume, as an average, a road 30 miles long, over which are made 100 round trips per day, with cars weighing 45 tons each, and assuming a loss of 25 per cent between the motors and the main power station switchboard, and taking the cost of energy at \$.006 per kilowatt hour we have

$$100 \times 30 \times 2 \times 45 \times 0.006 \times 365 \times 142 = \$111,952.80$$

as the cost of operating the 40-mile per hour schedule with single units and

$$100 \times 30 \times 2 \times 45 \times 0.006 \times 365 \times 99 = \$78,051.60$$

$$0.75 \times 1000$$

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as the cost of operating the 35-mile per hour schedule with single units.

The difference between these costs is \$33,901.20, which, at 5 per cent, is the annual interest on \$678,024. For a road 30 miles in length, the time between termini for the 35-mile schedule would be 51.4 minutes, while the time for the 40-mile schedule would be 45 minutes; a difference per trip of 6.4 minutes. The matter is also well brought out in the "run curves" shown in plates I, II, and III.

Earnings.—One of the most serious and inexcusable mistakes is that of computing or determining the probable gross income of a proposed new railway enterprise by the application of general average data to a specific case. The proper determination of the probable gross earnings for each or any case requires specific determinations and studies of the territory considered which will show: (1) Estimate and money value of probable passenger business between each of the centres of population and the principal terminus or termini, if both be important places. (2) Estimate and money value of probable passenger business between each of the centres of population between the termini and each of the remainder of such centres of population. (3) Estimate and money value of the probable annual excursion or recreation passenger business. (4) Estimate and money value of the probable express and freight business. (5) Rates of fare which are proposed to be charged. Should an existing road or roads be occupying the territory proposed to be served, the relation between existing rates of fare and the proposed rates is of course an important factor in this latter consideration.

As a matter of fact, instances of totally unoccupied territory are very rare. Trolley roads are almost certain to be in operation and, generally, in instances of most promise, steam roads will be found serving the territory after a fashion. A knowledge of the business of the existing railways operating in the proposed territory is generally of value and should be ascertained. For steam roads this can be readily done by purchasing one ticket, at each station within the territory to be served, to every other station on a certain day of the month, and then repeating the purchases at given intervals, say 10 days apart for some months. As each ticket has a serial number the existing local and through passenger business for any territory can be readily determined by noting the serial numbers and subtracting the numbers on those first purchased from those last purchased. This method will also show the variations of the passenger traffic.

The business of the surface trolley roads can be determined by stationing men at predetermined important places along the routes and noting the car number, time of day and number of passengers on each car as it passes a given point. For this work some experience is necessary to estimate the number of passengers on the car as it passes the observer. It is remarkable how accurate a little experience and care will make such observations. The difference in the number of passengers on a car as shown by the observations of the consecutive observers will show, approximately, the amount of local business or business between centres of population. These observations will also show, approximately, the total

trolley passenger business for the territory and will provide data from and for the actual case in hand, from which can be determined the rides per capita between the different centres of population. It is needless to say that the detailed data above noted will not be supplied by the existing operating railways, whence the necessity for the relatively large expenditure of the time and money to secure them. Should the proposed railway be one of great magnitude which will involve the expenditure of large sums for its installation, it is best to extend the observations over both the summer and winter months, as by so doing a more reliable average will be obtained.

Having now the approximate actual existing traffic business between each of the towns and the termini, as well as the local traffic between each of the towns, an estimate is made of the probable increase of traffic due to the increased facilities. Upon three branches of the New York, New Haven & Hartford Railroad which were changed from steam to electric systems, the following results were obtained:

COMPARISON OF PASSENGERS CARRIED PER ANNUM UPON CHANGING FROM STEAM TO ELECTRIC OPERATION.

Name of road	Passengers carried per annum operating by	
	Steam	Electricity
Nantasket branch.....	304,292	702,419
Highland division.....	387,695	1,060,617
New Canaan branch....	98,302	184,728

The systems cited, at the time these results were obtained, operated on hourly and half-hourly schedules. The differences would undoubtedly be much greater with shorter headways; these figures, however, show nearly 100 per cent increase as a minimum and about 270 per cent increase as a maximum.

An estimate should now be made of the passenger traffic which will come to the new road. Let there be seven towns, as A, B, C, D, E, F, and G, including the termini. Determine upon the average fares between each place, and let A', B', C', D', E', F', and G' be the respective populations of which A is the main or principal terminus. Let the estimated rides per capita from G to A equal N rides per annum, and the rate of fare between A and G equal R, then $G' \times N \times R = S$, which is the revenue which will accrue on account of the community of interest between G, the minor terminus, and A, the principal terminus. Proceeding in this manner for each town or population centre, we obtain the total estimated revenue. As a concrete instance will be more impressive, attention is directed to Tables II and III showing computations of this kind worked out by the writer.

earnings per capita taken from interurban statistics. Table II is computed from data upon the tics, which data were, however, not used until the existing railway earnings per capita for the case in hand had been determined by ascertaining the existing business. The railway earnings of places relatively remote from a large city are generally greater per capita for interurban railroads than those of the nearer places.

The above estimates of the earnings were made after a careful study of existing conditions, as well as of the nearest existing approximations, in the territory to be served by the New York &

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Port Chester Railroad. These investigations covered many months and had for their objects:

1. A careful study, after personal observation, of the habits of the people along the line; that is, ascertaining how, when, and where they traveled.
2. The existing inducements which would cause people to travel between the various cities and towns.
3. Ascertaining the occupations of the people and the probable stability of their employment.
4. Examination of the national censuses, as well as of the various ward, precinct, and school censuses.
5. Personal observations at the various points at which the public boarded trolley cars, at all hours of the day and night for many months, to count and ascertain the amount and division of the existing travel.

results given in Table II. Both methods can be used and should be in all cases of this kind where a careful study of the question of probable traffic is important. The figures obtained differ slightly from those reached on the population basis, but approximate so closely as to afford a satisfactory check.

In arriving at the probable earnings per capita, per annum (Table III), a careful study was made of the average railway fare expenditures per capita as they now exist in this territory, that is, the approximate amounts of money paid to the existing steam and trolley roads by the

TABLE II.—ESTIMATES OF EARNINGS ON POPULATION BASIS.

Between	Population carried per year	Average fare per trip	Annual income
Port Chester and New York.....	7,000 x 120	15 cents	\$126,000
Harrison, Rye and New York.....	2,000 x 120	15 "	36,000
Mamaroneck and New York.....	5,000 x 120	12 "	72,000
New Rochelle, Larchmont and New York.....	20,000 x 150	10 "	300,000
New Rochelle and Port Chester.....	30,000 x 60	5 "	90,000
Mount Vernon, Pelham and New York.....	28,000 x 150	6 "	252,000
New Rochelle and Mount Vernon.....	35,000 x 30	5 "	52,500
Mount Vernon and Port Chester.....	62,000 x 20	7 "	86,800
Bronx and Mount Vernon.....	100,000 x 50	5 "	250,000
Annual summer and recreation business of the road...	1,500,000	15 "	225,000
Total passenger income per year.....			\$1,490,300

A careful study of the business of the existing trolley and elevated roads and steam railroads operating in the district was made, as well as of the nearest existing approximations now operating elsewhere, and all data thus obtained were plotted, and therefrom the deductions here shown were drawn. It was found that this estimate contemplates carrying the population served approximately 100 times per year. The business will include 18,000,000 fares per annum. As these 18,000,000 fares are based upon approximately 4,500,000 car miles, it will be seen that there must be carried but four passengers per car mile; 18,000,000 divided by 365 = 49,300 passengers per day of 398 trips, or an average of 124 passengers per complete trip of about 22 miles. There are 22 local stations and 12 express stations, which would give, on an average, 6 passengers per station per trip for the local service, and 10 passengers per station per trip for the express service.

TABLE III.—ESTIMATES OF EARNINGS ON PER CAPITA BASIS BY DIVIDING TERRITORY INTO ZONES.

Between	Population	Earnings per capita	Total
Port Chester and New York	8,000	\$15.00	\$120,000
Harrison, Rye and New York	2,000	15.00	30,000
Mamaroneck and New York	5,000	15.00	75,000
New Rochelle, Larchmont and New York.....	20,000	12.00	240,000
Mount Vernon, Pelham and New York.....	30,000	10.00	300,000
New Rochelle and Port Chester.....	30,000	3.00	90,000
New Rochelle and Mount Vernon.....	45,000	3.00	125,000
Mount Vernon and Port Chester.....	80,000	1.50	120,000
Port Chester, Bronx and Mount Vernon.....	100,000	3.00	\$300,000
Total.....			\$1,410,000

Table III was worked out upon the zone system and for the purposes of checking the

residents of the different zones into which the district was divided for this purpose. In following out this method, 132d Street and Willis Avenue of New York city was taken as the centre, and circles with 132d Street and Willis Avenue as a centre were drawn, the radius of each circle being one mile greater than the other. In this way 25 circles were obtained. Had the circles simply been carried to the State line, but 24 would have been obtained. Inasmuch, however, as there is quite an extensive population immediately beyond Port Chester, Conn., all of which will have easy access to this road by using the existing trolley roads for a short distance, the Connecticut population was taken into account for a distance of three miles from what would be the end of this road. The population for one half of a mile on each side of this railway was obtained for each of the zones, that is, the distance between any two consecutive circles, and the riding data of this population determined. For the purpose of arriving at this information, a careful count during the summer and winter was made for a period extending over six months, of the number of passengers on the trolley cars at different points in this territory, as well as the number of people using the steam road at each of the stations in the territory under consideration. This information was obtained in the way already described.

When it had been obtained, a series of curves were plotted, showing the relations between receipts per capita and population served for different periods, and localities or zones. From the curves so determined, the figures for the receipts per capita given in this statement were summarized. Of course the estimated earnings per capita given in this summary are less than the results actually obtained, as the figures given are those estimated for the New York & Port Chester Railroad portion of the business only.

Table IV shows some of the results which now obtain upon a number of systems operating in and about various large cities of the United States. They are all city railway systems, and

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TABLE IV.—STATISTICS OF LARGE CITY PROPERTIES.

	Miles of track	Population	Gross receipts	Gross receipts per mile of track	Gross receipts per capita
Interurban Street Railway Co., New York.....	403	2,050,600	\$20,634,548	\$51.202	\$10.06
Philadelphia R. T. Co., Philadelphia, Pa.....	475	1,293,697	14,006,915	29.492	10.98
Brooklyn R. T. Co., Brooklyn, N. Y.....	523	1,166,582	12,510,622	23.921	11.94
Boston Elevated Ry. Co., Boston, Mass.....	387	741,062	11,060,380	28.580	14.88
Pittsburg Railways Co., Pittsburg, Pa.....	401	2750,000	8,276,560	20.640	11.08
Chicago Union Traction Co., Chicago, Ill.....	303	1,698,570	7,825,120	25.825	8.35
St. Louis Transit and Suburban Co.'s.....	455	2750,000	7,051,244	15.497	9.40
Chicago City Railway Co., Chicago, Ill.....	219	1,698,570	6,367,358	29.073	8.35
United Railways of San Francisco, San Francisco, Cal..	244	2375,000	5,553,904	22.762	14.81
United Railways & Electric Co., Baltimore, Md.....	314	508,957	5,040,270	14.241	9.90
International Railway Co., Buffalo, N. Y.....	353	2500,000	4,426,675	11.540	8.85
Twin City R. T. Co., Minneapolis, Minn.....	255	366,350	3,591,540	14.084	9.80
Detroit United Railway, Detroit, Mich.....	380	6303,120	3,501,754	9.215	11.55
Cincinnati Traction Co., Cincinnati, O.....	210	325,002	3,315,751	15.789	10.17
Milwaukee Electric Railway & Light Co., Milwaukee, Wis.	146	285,315	2,302,514	15.770	8.08

a. Local estimate of city and suburb, 1903. b. Local estimate, 1901.

with the exception of the Interurban Street Railway Company of New York, all trolley roads. In most cases, the figures for traffic are for the fiscal year 1902, while the population, unless otherwise indicated, is for 1900. The population given is that of the city in which each company operates. The column of gross receipts gives the entire receipts from passengers of the respective companies, including the receipts from branches extending outside of the city limits, so that the "gross receipts per capita" are in some cases slightly higher than they would be if they showed the receipts of the actual population served. The Brooklyn and Boston figures include the receipts from the elevated lines in those cities, as these systems in each case are operated in conjunction with the surface systems, and their receipts cannot be separated. Where there are two or more companies in the same city the "gross receipts per capita" show the gross receipts of all of the surface street railways in the city.

In cases where there are no existing steam railways serving the population to be connected by the electric lines it is advisable to count the traffic by vehicles and stages between the different centres of population for periods sufficiently long and at proper intervals to give a fair annual average. From this information and by comparison with the traffic of existing roads in similar conditions a fairly satisfactory estimate can be secured. In such comparisons the "population served" may very properly be considered to be that residing within about 1½ miles on each side of the proposed line, in cases, of course, where there is no other railway serving them. The entire population of large terminal cities should not be added to the total sought, as all the residents of such city will not be probable patrons of the railway. In making per capita comparisons of this kind between a proposed and an existing railway it is often better, where both have a large terminal city, to leave this city out of account in both instances. An even better plan, where the riding between stations on the operating road is known, is to make the comparison on the zone system, as already described.

Thus far the method which should be followed in determining the probable gross passenger earnings only of any interurban system has been described. The matter of determining

the gross passenger earnings has been gone into somewhat in detail, for the reason that upon roads of this character the passenger earnings at present are by far the greater portion of the total gross earnings.

In addition to passenger earnings, however, estimates should be made of the probable gross revenue which will be derived from the carrying of freight, express, and mail. The data now available on this subject are not very complete on account of the fact that this branch of the interurban business has not yet been developed and systematized sufficiently to be able to furnish accurate data. For any special case, however, the gross freight and express business can be worked out and determined by a process very similar to that used in determining the gross passenger revenue. The process consists, first, in ascertaining the amount of freight and express business coming into and going out by railway of each of the centres of population (in cases where an existing steamroad is doing this business), and then determining what proportion could be secured by the electric road. Should there be no existing steam railway, the method of procedure would be to ascertain the total production and consumption of the territory proposed to be served, which would include, of course, products of all kinds, that is, agricultural products and mining and manufacturing products. An estimate of the gross tonnage from every point along the line of the proposed road can then be made to the points at which the freight would probably be carried, such as some large city or some other connecting road.

In estimating freight traffic for towns where there is no existing road supplying the population, and, consequently, where no actual approximate railway data can be obtained for the probable ingoing and outgoing freight receipts of any single or number of population centres, another way to proceed is to ascertain the population of each of the population centres, and then have recourse to statistical data published by the United States and other governments, showing consumption and production per capita for given localities. From such data, an estimate can be made of the probable railway tonnage for the proposed road. Such an estimate will, of course, show the tonnage which would accrue on account of a service, such as is now

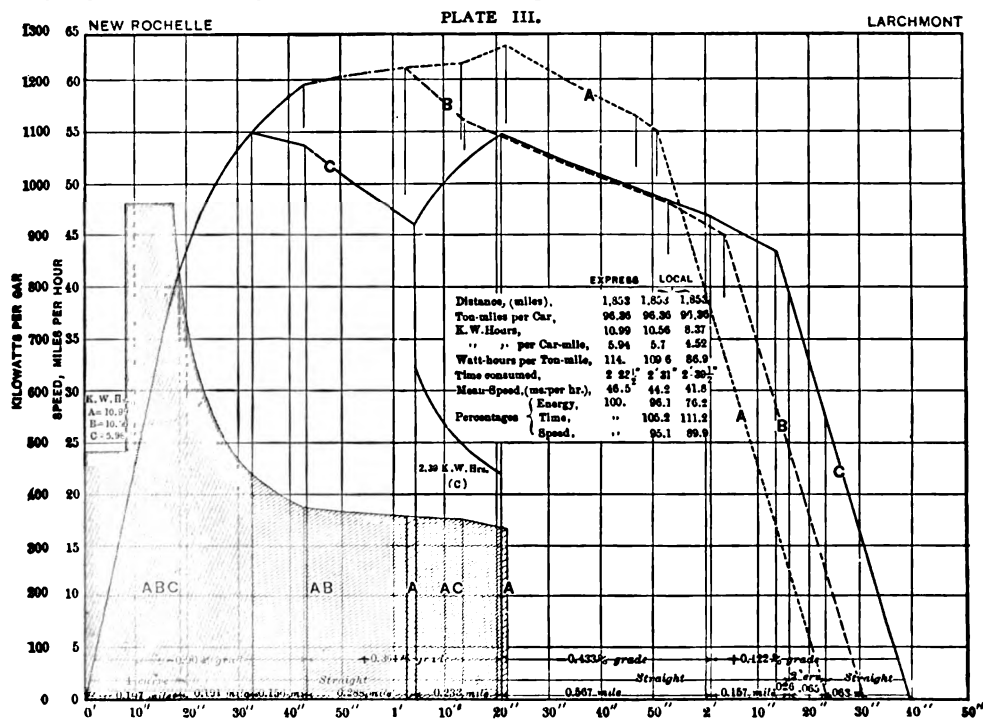
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in existence around the country, that is, the ordinary steam railway service. There is no doubt, however, but that the actual tonnage for an electric service operating frequent units would be greater than that enjoyed by existing steam roads. Instances often exist where freight and goods are taken out and into a community by means of wagons plying to and from railway centres distant anywhere from 5 to 10 miles from the community. Where such cases exist fairly accurate data can be obtained by ascertaining the business which is done by such wagon service.

There is no doubt that such relatively high-speed, high-class interurban electric railway systems which are here being considered and which are to play an important if not revolutionary part in transportation economics,

mile of single track per year from freight and express, and this in cases where the whole or the major part of the tracks are on public highways, and where, consequently, the schedules are limited to 16 or 20 miles per hour, which is a perpetual handicap to interurban high-speed railways so designed and installed.

Expenses.—In connection with electric railway operation, an unfortunate habit has developed of estimating the annual costs of operation and maintenance as a percentage of the gross receipts. Estimates of this kind really mean nothing and have no real value even for comparisons. They are even dangerous when used in such computations and determinations as discussed here, on account of the difference in conditions, such as number of cars operated, length of route, headway, average distance each



Comparative run curves determined for an actual case showing economic results of different schedule speeds. See and compare table in centre.

will soon attain gross passenger earnings of from \$12,000 to \$15,000 per mile of single track per year and more, and will also attain additional earnings from freight, express, and mail business of from \$2,000 to \$3,000 per mile of single track per year. This refers especially to roads operating at schedule speeds of from 30 to 40 miles per hour and more, on private rights of way, connecting large centres of population and having stations or stops from a quarter of a mile to a mile or more apart, running cars at frequent headway, and when designed and installed by competent railway experts, fitted by experience to judge of the present and future economic activities of given conditions. Already some of the better classes of electric interurban roads are obtaining \$10,000 to \$12,000 per mile of single track per year from passengers, and \$1,000 to \$1,200 per

passenger is carried, and tributary population per mile of track, and especially relative receipts, etc. In order to use the percentage of the gross receipts method in making comparisons, some of the details of operation should accompany the statement of the percentage of gross receipts required to operate the road. Such accompanying details should show: (1) The gross receipts. (2) The car mileage operated daily and yearly. (3) The average daily mileage per car. (4) The total number of miles of single track operated. (5) The amounts annually expended for maintenance of way and structures, and maintenance of equipment, and the amounts per car mile for these items. (6) The physical condition of the property. (7) The capital liabilities and fixed charges. (8) Traffic density or passengers carried per car mile.

Of two roads having approximately the same

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amount of track, the one operating at the larger percentage of the gross receipts may have the larger net. Suppose one of two such roads to have gross receipts of \$1,500,000, and to be operating at 60 per cent of its gross receipts. Suppose the second of the two to have gross receipts of \$900,000, and to be operating at 50 per cent of its gross receipts. In the first case, the net will be \$600,000, while in the second case it will be but \$450,000. If each has approximately the same amount of track, the fixed charges will probably be nearly the same. This instance will show the necessity for additional detail if such data are used.

The only safe way to proceed is to determine the detail cost of each item entering into the total cost of operation. The subject is generally divided into four subdivisions by existing steam and some electric systems, as follows: (1) Cost of maintenance of roadway and structures. (2) Cost of maintenance of equipment. (3) Cost of conducting transportation. (4) General expense.

Any item of operating costs can be classified under one of the four heads above given. It is more satisfactory to use the following subdivision for electric systems:

1. Cost of train crews.
2. Cost of station men, such as ticket agents, etc.
3. Maintenance and inspection of cars and equipment.
4. Maintenance of roadway and structures.
5. Cost of operating main power station, including fuel, oil waste, etc., and labor and repairs.
6. Cost of operating rotary stations.
7. Salaries of officers and clerks, etc.

TABLE V.—APPROXIMATE COSTS PER MILE OF SINGLE TRACK.

Items	Maximum	Minimum
Rails, 80 lb. T (\$33 per ton delivered, including splice plates, bolts, spikes, and drilling)	\$5,100.00	\$4,460.00
Cost of labor for handling and laying	900.00	900.00
Track bonding	1,750.00	1,400.00
Ties, 6 x 8 x 8, at 70 cents each	1,848.00 (2-foot centres)	1,474.00 (30-inch centres)
Rock ballast, 10 inches deep, 11 feet wide, and carried to top of tie	4,125.00	2,062.50
Graduation	6,000.00 (Crushed stone 1.50 per yard) (20,000 cubic yards per mile of track)	1,800.00 (Crushed stone, 75c. per yard) (10,000 cu. yds. per mile of track)
Third rail	7,000.00	3,400.00
Copper or other electrical conductors, and installation thereof	2,500.00	1,500.00
Bridges and culverts	12,000.00	4,000.00
Labor and incidentals	400.00	200.00
EQUIPMENT		
Rolling stock, motors, and equipment from \$10,000 to \$5,000 per car	8,000.00 (At five minute headway)	1,000.00 (At one hour headway)
Power-stations at \$100 per kilowatt, substations at \$40 per kilowatt, etc.	18,000.00	4,000.00
Incidentals, including block-signal system, telephone and telegraph, fencing, etc.	4,000.00	1,000.00
Real estate for right of way	20,000.00	1,600.00
Total	\$90,623.00	\$27,796.50

Each factor of each of the foregoing items should be carefully computed and the total cost of operation and maintenance thus ascertained. This is the only safe and true way of arriving at a proper conclusion.

The fixed charges include the following items: (1) Interest on bonds or other interest-carrying obligations. (2) Cost of leaseholds or rentals. (3) State and other taxes. Taxes are often placed under the head of operating expenses. They are sometimes determined as a percentage (from 2 to 5 per cent) of the gross receipts. Space will not permit an extended discussion of the details of the computations of the costs of construction and equipment. Table V. will give data from which such costs can be determined. In each instance, however, every item of the cost of construction and equipment must be computed and determined.

Equipment.—Among the most important and trying economic questions relating to the design, construction, and operation of high-speed electric railways reaching well out of the congested centres of population, which the designing and managing engineers are called upon to decide, are those relating to the character of construction and equipment to be adopted, and the character and kind of service to be given. These considerations may be stated as follows: (1) Number of tracks to be installed. (2) Speed, headway, and size of the train units. (3) Weight of rails and characteristics as affecting costs, of ties, ballast, block signal system, and other details of permanent way. (4) Character of rolling stock and power stations and transmission system, together with the location, design and number and character of the passenger stations.

All of the foregoing are functions of the estimated gross earnings of the proposed installation. The earnings must be taken as the starting point. At the present time the plans of some proposed systems appear to indicate a tendency, in some instances, to do too much. There appears to be, in some cases, a lack of appreciation of the proper relations which should maintain between fixed charges and the estimated gross receipts. In some cases, which I have investigated, the fixed charges upon installations, as proposed, equal 40 per cent to 50 per cent of the estimated gross receipts, a margin far too close for safety. For the cases of a number of the higher class steam roads in operation the fixed charges are found to vary between 20 per cent and 30 per cent of their actual receipts. On account of the demonstrated ability of electric systems to develop business more rapidly than their steam predecessors the above ratio of the steam lines may at times be exceeded in such cases where the estimated earnings have been conservatively made by experienced engineers. It is always best, however, to keep on the safe side, and let the earnings, after the proposed system is operating, do something toward augmenting the installation. If this latter course be followed it is safe to say that the officers and stockholders of the company will not have "nearly as many sleepless nights as they otherwise may have should they too ambitiously "reach out and lead." In addition, there will probably be less activity in the receivership and absorbing and reorganization businesses.

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Generally speaking, the idea should be to install no more tracks than can be kept busy safely and satisfactorily, taking care of the business in sight and which apparently will accrue from the first few years of development, on account of the increased or improved facilities proposed to be given. Relatively high speed for these roads must be maintained. Again, in attempting to get as much out of a pair of tracks (single-track roads being out of the question) as possible, it must not be lost sight of that while the capacity of a given installation with a given schedule speed can be increased by gradually adding train units up to a certain point, a limit will be reached, after which, on account of the headway requirements, any increase in the number of units will necessitate a reduction of the schedule speed, and if carried far enough, the carrying capacity will be actually reduced; any material reduction of schedule speed will probably also cause a loss of traffic. If a schedule speed of 30 miles per hour has been determined upon as that which will be required for a given territory, the idea should be to ascertain the maximum capacity of say two tracks for the proposed road when operating at that schedule. If it be ascertained that the two tracks will not be sufficient, at the determined schedule to carry the maximum estimated business, then a third track, to be used for express trains going one way during the morning and the other way in the evening, should be estimated upon. It will generally be found that wherever a third track is warranted the conditions will generally admit of the small additional outlay required for a fourth track. The additional costs are those required for the relatively slight additional graduation (earth and rock-work) and the additional rails, ties, and ballast, and the labor of installation. In cases of supplying the suburbs of such cities as New York, Boston, Paris, London, Berlin, Chicago, and San Francisco, and similar cities, it will generally be a question of determining whether two tracks or four tracks should be installed, and the safe and conservative solution will always be arrived at by considering the comparative ratio of the different fixed charges, which two, three or four tracks will impose to the probable gross receipts, estimating the gross receipts for the conditions which will exist when the road commences operation. In some instances, where a rapid growth and development is apparent, such future development must be allowed for in the original design.

As an illustration of the application of the foregoing principles suppose the estimated gross receipts of a proposed road are \$900,000 per annum. Suppose, furthermore, that a two-track road could be installed to do this business for \$5,000,000, and that a four-track road would cost \$6,000,000. The fixed charges for the two-track road, at 5 per cent, will be \$250,000 per year, while on the same basis, those for the four-track road will be \$300,000. The annual operating expenses, taxes, and insurance would be about \$500,000, for the conditions assumed for the two-track road, leaving for the two-track road \$400,000 for fixed charges, etc. Deducting the \$250,000 fixed charges of the two-track road would leave \$150,000 annually to be applied to unforeseen contingencies, betterments, and other

accounts. If we assume that we will run approximately the same number of train units between the termini daily for the four-track road at the start, the operating costs will be about the same. In order to justify such an assumption it would, of course, be necessary to reduce slightly the schedule of the two-track road, which can at times be done. For the case of the four-track road we will then have left, after deducting say \$525,000 for the annual cost of operation, taxes, and insurance, the sum of \$375,000 for fixed charges, etc. If we now deduct the fixed charges of \$300,000, we have left \$75,000 for unforeseen contingencies, bad times, betterments, and other accounts, a margin which is somewhat too small for the solid comfort of the bondholders and the stockholders, especially that of the stockholders. In fact, an enterprise starting upon its career upon the last basis might well be called a "receiver's delight," a "reorganizer's joy," or a "stockholder's obsequies" installation. A four-track installation for the case we have assumed would only be justified where a great immediate development along the line of the road was apparent. Even then the engineer should prepare statements of both conditions, as above outlined, and submit them to the bankers or underwriters so that they will have full knowledge of the relative conditions and contingencies.

The development of large cities and the consequent apparent exceeding of the capacity limits of some existing rapid transit or urban rapid transit system has offered opportunity for much lay, semi-professional, and even so-called engineering criticism of the shortsightedness of the originators of such transportation systems in not installing more tracks at the time of the original construction. If such critics will investigate they will ascertain that, generally speaking, such roads have been hard pressed for many years to make ends meet, and that they are now only reaping their hard-earned fruits. A little thought will also show that had such systems at the outset provided installations adequate to do the business they are now receiving, they would certainly, in years past, have suffered financial difficulties, to state it mildly. As a general rule promoters and financiers are fairly healthy, and in cases where they are not entirely so there are other and milder means than that of placing large amounts of money in relatively certain jeopardy, by reaching out and leading, of recruiting their exhausted energies.

The very best materials and construction only should be employed for the permanent way and the rolling stock, as it is only by so doing that the maximum safety can be assured to the traveling public, which must always predominate in considering costs of construction. Accidents are always costly, as are also conditions of uncertain operation and delays. The public will not patronize a road upon which accidents are frequent or whereon uncertainty of operation or delay is at all marked. Inferior permanent way and rolling stock is, therefore, equivalent to burning the candle at both ends on account of the natural reduction of receipts, for the reasons stated above, and the additional increase of operating and maintenance costs which maintain on poorly engineered and poorly installed railways.

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Regarding the determination of the details of the passenger station. It should never be lost sight of that the location of the passenger stations may have a material influence upon the business which the road will do, depending upon whether the stations are located so as to render them easy of access or otherwise. The matters of the general design, size, finish and specific details of the station will have to be determined separately for each case.

In designing the stations, however, the object should be to provide stations wherein the annual aggregate salaries of ticket sellers and attendants will be a minimum. If ticket offices be placed along each side of the roadway at each station this will not be the case. The stations between the tracks on some elevated systems, known as "island stations," are examples of the minimum operation and maintenance cost idea. About half the annual attendance is required for such stations as compared with those on each side of the tracks. The objection sometimes urged against the "island station" system is that people who are so disposed can ride back and forth any number of times after paying a single fare. In connection with the development of the engineering details, of a railroad designed by the writer in New York State, the tracks of which will be upon a private right of way throughout, and furthermore, upon earth or rock cuts or fills, the writer devised and recommended the following station plan: Wherever the roadway is on an embankment and above the grade of the streets, the station is to be constructed by providing under the roadway and approximately at right angles to the tracks, a passageway or tunnel extending entirely across and under the railway roadway, and 50 feet or more, as may be required, in width. The width of this passageway would, of course, be along the length of the tracks. In the centre of this passageway is to be one ticket office, provided with proper approaches, from each side of the roadway; and inside of and beyond the ticket office are to be waiting-rooms, etc., and the stairs ascending to the island platforms between the tracks. This underground passageway is to be of the concrete-steel construction. Where the tracks are in a cut, at station locations, and consequently beneath the surface of the streets, the design provided for a concrete-steel structure over and entirely across the tracks, wherein is located one ticket office, as before, with waiting-rooms, etc., inside the ticket office, and stairs descending to the island platforms. Stations of this kind are worth about \$8,000 each. It is evident that the same plan can readily be used for a two-track road.

Where a high-speed electric railway crosses a public highway or other railway, either above or below the grade of the other road, the design of such a crossing, especially where it is below, and consists of a subway of greater or less length, may exercise considerable effect upon the subsequent cost of operation of the system, as it may determine the limiting length of the cars where trains are used. The high-speed railways herein discussed should be designed throughout so as to permit of the operation of any of the cars now used by steam railways. There is, however, another reason of essentially

an economic kind. As an illustration, suppose that upon a given road it has been found that on account of the dimensions of part of the subways it will not be possible to use a car more than 40 feet in length, and that train units of three such cars will be required. It is apparent that train units consisting of two 60-foot cars would carry the same number of people as the three 40-foot cars, and allowing one conductor or guard per car, at an operating cost of one man per train unit less. It is easy to see that if train units be operated at frequent headway and for any considerable part of the day, the length of the cars becomes a most important consideration and economic factor of the subsequent costs of operation. Mistakes of the kind have occurred and are now practically the cause of considerable additional fixed costs of operation, which would have been avoided had such apparently small details been given that thorough and competent consideration at the outset which their economic importance demands.

Engineers or experts in making reports often appear to forget or ignore the fact that the essential value of their reports lies in the conclusions, and a brief statement of the bases for these conclusions. The body of a report may contain as much statistical detail and general data as may be required to pad out the document to make its outward appearance justify the fee; but the client, upon receiving the document, will generally search the index for that part of the report giving the conclusions, and the bases therefor. Often the search is in vain.

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Railway Engineering, in its broad sense, comprises the work of the civil engineer and the mechanical engineer. The first includes the design, construction, and maintenance of the statical structures, such as the track, bridges, buildings, etc., the second, the design, construction, and maintenance of the motive power, machinery, cars, marine equipment, etc. The term railway engineering is, however, usually used in a limited sense meaning the work of the civil engineer only. It is the purpose of this article to enumerate the general items of work included in railway engineering, and to state briefly the important facts, methods and principles used by the railway engineer in his work. It will be assumed that the reader is familiar with such simple terms as single track, double track, rails, cross-ties, etc., and knows the general form of a railway track in so far as a casual observation reveals it. Bridging, tunneling, and masonry, being covered elsewhere, will not be treated.

Railway Design includes the determination of the general route, and the details of the alignment and gradients of a road, called the location; the determination of the cross sectional form and dimensions of the embankments, excavations, tunnels, ballast, etc.; the determination of the form and dimensions of cross-ties, or sleepers, the form and weight of the rail and its fastenings, the necessary water way to safely pass the water of the various streams and gullies crossed, together with the form and dimensions of the culverts, trestles and bridges; the

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design of road crossings, grade, overhead and overhead; the design of docks, warehouses, coaling stations, water-supply works, minor buildings and yards.

Railway Construction is usually performed for the railway company by a contractor. In this case, the railway engineer lays out the work on the ground, measures the quantity of work done, and maintains a general supervision to see that the terms of the contract are complied with. The chief engineer is usually by the terms of the contract the ultimate authority out of court in the interpretation of the provisions of the contract, and he has complete control of the work done under it. When a railway company executes its own work, the engineering department devises the methods of work, secures the necessary tools and machinery, employs and supervises the labor, and in general directs the work, which is done under a superintendent of construction.

Railway Maintenance includes keeping the constructed track in good surface and alignment, from which it is distorted by the action of frost, rain, and the heavy loads going over it; replacing worn out or decayed cross ties; renewing worn out rails; keeping the drainage ditches open, grass and weeds cut, fences in repair, bridges and all other structures in repair; occasional rebuilding of whole structures; laying out and building side tracks and spur tracks to quarries, factories, gravel banks, etc., and maintenance of the water supply works.

Railway Improvement, besides the building of larger and handsomer station buildings, the purchase of larger cars and locomotives, and the improvement of station grounds and roadway, items that appeal to the general observer, includes the far more important but less conspicuous work of reducing the curvature, shortening the line, rearranging the gradients by reduction where possible and adaptation to pusher service where they may not be much reduced, and redistributing the locomotives on the road so that each one may be on that portion to which it is best adapted. This work is usually done under the combined direction of the civil and mechanical engineering departments.

Railway Alignment.—The horizontal plan of the centre line of a railway is a series of straight lines connected by curves. The straight lines are called tangents, because they are tangent to the curves joining them. Formerly these curves were arcs of circles, but they are now almost universally combinations of circular arcs and what are known as easement or transition curves, or spirals. The central portion of the curve joining two tangents is an arc of a circle of some selected radius, and between this central portion and the tangents connected by the curve are two easement curves or spirals, one for each tangent. These curves are not simple arcs of circles, but are curves having a constantly changing radius. Beginning at the tangent with a radius infinitely long, the arc just at this point being practically a straight line, the radius continually decreases, the curve becoming sharper and sharper, till it is reduced to the radius selected for the central portion of the curve at the point where the spiral joins that central portion. An easy transition from tangent to curve is thus secured, and the shock to

the track and passenger greatly reduced or entirely eliminated. The circular curves are known by their degrees, that is, the number of degrees subtended at the centre of the circle by a chord of 100 feet. If a chord of 100 feet subtends 4 degrees at the centre of the circle, the curve is known as a four degree curve. The radius of a one degree curve is 5729.65 feet, usually assumed as 5,730 feet. The radius of any other curve is approximately inversely as its degree. The radius of a 10 degree curve is one tenth that of a one degree curve. This relation is not exact. A one degree curve is a very light curve, a ten degree curve about the sharpest in general use on Eastern trunk lines, a 24 degree curve about the sharpest on Western mountain lines, and 40 degree curves about the sharpest in railroad yards. Curves of 90 feet radius occur on the elevated railways of New York.

The Gauge of a railway is the cross distance between the inner sides of the heads of the rails. Standard gauge, almost universally used in the United States, is 4 feet 8½ inches. A gauge of one metre is used to some extent in the Spanish-American states, in Japan, Russia, and some other European countries. Until within a few years a gauge of 7 feet was in use in England. A gauge of 4 feet 9 inches is in limited use in the United States. A gauge of 3 feet was used to some extent in the United States, but has been almost entirely replaced with standard gauge. The transfer of the cars of one road to the tracks of another, making frequent unloading and reloading unnecessary, requires the tracks of any one continent, or country, to be of practically one gauge.

Traction is the act of drawing. That which enables a locomotive to draw a train is the friction between the driving wheels and the rails. When the pressure of the steam in the cylinders, transmitted through the connecting rod, tends to turn the driving wheels as the fly wheel of a stationary engine is turned, the friction between the wheels and the rails prevents such turning, and causes the wheels to roll along the rails carrying the locomotive and train with them. The amount of this friction varies with the condition of the rail. In summer, with a clean rail, it averages about one fourth of the insistent weight; in winter it is about one fifth; and when sand is used in summer, it may be increased to about one third of the insistent weight. Thus, if a locomotive weighs 209,000 pounds, 144,600 pounds of which is carried on the driving wheels (proportions of an existing modern heavy passenger locomotive), the average maximum pulling force that can be exerted by the locomotive in summer will be about one fourth of 144,600 pounds, or 36,150 pounds. This quantity is known as the tractive effort of adhesion. The locomotive will be able to exert this pull if the boiler and cylinder capacity is sufficient. It usually is when the speed is very low, but since a boiler is designed to give a certain maximum horsepower, when the speed is fast, the pull must be correspondingly light. Practical considerations make it impossible to design a boiler that will permit the development of the full tractive effort of adhesion at high speed. A locomotive of horsepower P , driven at a speed of S miles an hour will be able to exert a pull in pounds equal to $375 P \div S$.

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This is a theoretical value and must be discounted about 10 per cent because of frictional losses in the engine. With slow freight trains speeds of from 5 miles to 10 miles an hour may be permitted, and hence the full tractive effort of adhesion may be had on the steep grades where it is required, and greater speed may be made on the more level stretches where the tractive effort required is not so great. The most economical speed for freight trains is a disputed question. It is generally considered to be the fastest speed the train can make over the whole road or division when the locomotive is loaded with the greatest load it can draw at minimum speed on the steepest, or ruling, grades.

Train Resistance is measured by the effort required to draw a train on a straight and level track. This effort depends on the condition of the track and wheels, atmospheric temperature, the lubrication of the bearings, the direction and force of the wind, and the speed of the train. Many efforts have been made to devise a formula that shall correctly express the effort for varying speeds, but as may be inferred from the number of variable conditions, no formula giving precise values is possible. Freight train resistance is usually considered to be about 5 pounds for each ton of weight of train for usual freight train speeds of from 12 miles to 15 miles per hour. This means that if a train weighs 1,000 tons, a tractive effort of 5,000 pounds will be required to draw it on a straight and level track at usual freight train speed. To start the train will require a greater effort, because the resistance at starting is much greater than at sensible speeds. Were it not that by reason of the springs in the draught rigging the train is started a car at a time, no locomotive could start the train it habitually hauls over the track. This does not apply to fast passenger trains, the locomotives of which, being never so heavily loaded, have a surplus of tractive effort for starting quickly. Freight train resistance is least at a speed of about 6 or 8 miles an hour, and increases nearly as the speed, being about 8 or 9 pounds at 25 miles an hour. Train resistance is sometimes known as rolling resistance. There are two other sources of resistance taxing the adhesion, or tractive effort, of the locomotive, namely, grade resistance and curve resistance.

Grade Resistance is the action of gravity on a train on a grade tending to pull the train down the grade. It amounts to practically 20 pounds per ton of train weight for each per cent of grade rate. Thus, a grade rising 1 foot in 100 is a one per cent grade, and offers a resistance to an ascending train of 20 pounds for each ton of train. A grade rising 3 inches in 100 feet is a 0.25 per cent grade, and offers a resistance of 5 pounds per ton of train, or doubles the traction necessary on a straight and level track. Such a grade is considered a light grade, a 0.5 per cent grade is a moderate grade, and a 1.0 per cent grade a heavy grade, though on mountain roads in the Western United States grades of 4 per cent are common, and there are some heavier. When grades exceed 5 per cent or 6 per cent they are usually operated by cable or by specially designed locomotives carrying a gear wheel which engages in a rack built along the track. Perhaps the most elaborate cable line is the Mahanoy plane of the Philadelphia and

Reading Railway, used to lift coal out of the Mahanoy Valley. Examples of rack railways are the Mount Washington Railway and the railway up Pike's Peak, planned for tourist and pleasure travel.

The Ruling Grade of a road, or division, is that grade which, because of its resistance, limits the train the locomotives used can haul. Such a grade therefore determines the number of trains necessary to do a given volume of business and is the most important feature of railway design. The ruling grade is not necessarily the steepest grade on the road. The steepest grade may occur but once, and be operated by assistant engines, a single locomotive hauling the train, heavier than it could haul unaided over the steepest grade, over the remainder of the line. Or the steepest grade may be so short that the train approaching it at high speed is carried over by the combined effort of the locomotive and the energy stored in the train by reason of its high speed. Such a grade is known as a momentum, or velocity, grade. To determine the load a given locomotive can haul on a given grade, Divide the tractive effort of the locomotive by the sum of the rolling and grade resistances, the result will be the gross load in tons. To determine the load behind the tender, Subtract from the foregoing result the weight of engine and tender. The locomotive mentioned earlier in this article, having a tractive effort of adhesion of 36,150 pounds, on a 0.25 per cent grade at low speed, could just draw a load determined by dividing 36,150 by 5 pounds per ton rolling resistance plus 5 pounds per ton grade resistance, or 10 pounds, giving 3,615 tons gross load. The total weight of such a locomotive and its loaded tender would be about 172 tons, therefore the net load behind the tender would be 3,443 tons. It is frequently claimed that an electric motor car can climb a steeper grade than can a steam locomotive, the popular belief being that some attraction between wheels and rails in the case of the electric car is the cause. It is true that an electric motor car of usual form can ascend a steeper grade than can a steam locomotive of usual form and equal weight and power. There are two reasons for this: 1. Gearing is a more certain and steadier method of transmitting power at low velocities than the reciprocating motion of steam pistons and connecting rods. 2. As usually built there is a motor on each axle of a motor car making all the wheels driving wheels, and the total weight available for traction, while a considerable proportion of the locomotive is carried on truck wheels, and hence is not only unavailable for traction, but is a direct tax on the tractive effort that is available. Assuming the high value of 10 pounds rolling resistance, an electric motor car with a motor on each axle would be just about in equilibrium, if it could start, on a 24½ per cent grade, while the locomotive mentioned earlier in this article would be in equilibrium on a 16⅓ per cent grade. No such grades could be operated. About the steepest grade operated by an electric car is 13 per cent, but such a grade is dangerous, and safety appliances should be used. The danger lies in the fact that if the wheels once begin to slip, the coefficient of friction is immediately reduced to less than one tenth, and moreover, the brakes are not infallible. Driving wheels of locomotives are seen to slip

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even on straight and level track, particularly at starting. This is because the great resistance to starting overcomes the adhesion, or because the engineman admits steam to the cylinders too suddenly and freely.

Assistant Engine Grades steeper than the ruling grade may be occasionally necessary to avoid great expense of construction. When such grades occur at or near a station, or yard, a switching engine may be used to help the trains up the grade, but when such grades occur out on the line, special engines must be kept at the foot of the hill. Such engines help the heavy trains over the hill and return light, without train, to the foot. To determine how steep a grade may be operated with the aid of one assistant engine of the same power as the through engine, Add the weight of the assistant engine to the weight of the through train, and find on what grade the combined tractive effort of the two engines just equals the total resistance of the entire train. The problem is just the reverse of finding the load an engine can haul on a given grade.

Momentum Grades find favor with railway managers of the Western United States and Canada, and are in operation in those portions of America, enabling heavier, and consequently fewer, trains to be run than would otherwise be necessary. Managers of heavy traffic lines in the Eastern United States regard the consideration of such grades with disfavor, holding that the accidents of traction are so great and uncertain that it is unwise to send out a locomotive with a train of greater weight than that with which the locomotive can start from rest on the steepest grade over which it must pass. The consideration of momentum grades involves two problems, one when a new line is being built, the other when re-arranging the train loads for locomotives on an existing line. The first is the determination of the length of grade, steeper than the ruling grade, that can be surmounted by a given locomotive loaded with a train proportioned for the ruling grade; the second is the determination of the weight of the train that a given locomotive, aided by velocity of approach, can carry over a grade of given rate and length. In each case the velocity with which the grade may be approached must be known. Neither of these problems is capable of exact solution, but both are capable of comparatively simple approximate solution. On an existing line a dynamometer car is of great service in studying economical locomotive loading and grade arrangement.

High Mountain Levels, if narrow ridges, may be tunneled; but if broad table-lands with steep approaches, may be reached by one of several methods adopted to secure practicable grades: (1) Zig-zag development, which means laying the line back and forth across the general direction of the route, gradually climbing the hill on a permissible grade, turning nearly a half circle at each end of a lateral stretch until the summit is reached. (2) Switch-back development, which is zig-zag development without the necessary room for turning at the ends of the lateral stretches necessitating the use of switches at these ends and the backing of the train up alternate stretches. Switch-backs must always be located in pairs to permit regaining a for-

ward movement of trains. (3) Spirals or loops, which are formed by the line advancing in a more or less continuously curving path, constantly rising and finally crossing itself over a tunnel or bridge. Noted spirals in the United States are the Union Pacific Georgetown branch loop in Colorado, and the Southern Pacific Tehachapi loop in California. The Mount St. Gothard railway has one spiral on the Swiss side and four on the Italian side of the mountain, almost complete circles, and almost entirely in tunnel.

Curve Resistance arises from two principal causes: (1) Car wheels are fastened rigidly to the axles and hence do not turn independently. They are of practically the same diameter, and in rolling a given distance should make the same number of revolutions. But the outer rail of a curve is longer than the inner rail, and hence either the outer wheel must slip forward on the rail, the inner rail must slip backward, or both slippages must occur. (2) The direction of motion of the wheels must be constantly changing. This change is affected by the pressure of the flange of the forward outer wheel of a car truck against the side of the rail head. Both of these conditions introduce friction which must be overcome. The amount of curve resistance is not definitely known, but such observation as has been made indicates that it varies from a half pound per ton of train weight per degree of curve to two pounds per the same units. It is usually assumed at one pound. Thus, to draw a train on a 5 degree curve will require an effort of 5 pounds per ton of train weight, or as much as to draw a freight train on a straight and level track. If such a curve occur on a 0.25 per cent grade, the total effort required to draw the train will be 15 pounds per ton, 5 pounds for rolling resistance, 5 pounds for grade resistance, and 5 pounds for curve resistance. When curves occur on grades approximating the ruling grade so that the combined resistance of curve and grade exceeds that of the ruling grade alone, the grade throughout the curve is reduced sufficiently to make the total resistance no greater than that offered by the ruling grade. This is called compensating for curvature. The amount of reduction is usually 0.05 per cent for each degree of curve.

Elevation of the Outer Rail.—The passage of a train at sensible speed around a curve generates centrifugal force tending to cause the train to leave the rails or overturn. This force is greater in proportion to the square of the speed, and less as the radius of the curve is greater. It is counteracted by canting the track, usually called elevating the outer rail, so that the effect of gravity tending to pull the train down the inclined plane toward the centre of the curve shall just equal the centrifugal force generated, or rather, so that the resultant of the weight and centrifugal force shall be perpendicular to the plane of the track. It will be evident that in passing from a straight line to a curve, since the centrifugal force is instantly generated, the full theoretic cant of the track should begin at the beginning of the curve. This is possible with the modern easement curves, but was impossible with curves as formerly laid out when the circular curve was itself tangent to the straight line. The practice then was to begin the canting back some distance on the

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straight line, increasing it gradually till the full amount required was had at the beginning of the curve.

Cost of Operation is an important item of information to the locating engineer. He is particularly interested in the cost of running trains, usually stated by the train mile, that is, one train run one mile. From this cost known in great detail, he separates those items that vary with the physical characteristics of the road and which may therefore be influenced by his design, and endeavors to determine what additional cost would result from the addition of a mile or a foot to the length of the line, the cost resulting from the introduction of a degree of curvature, or a foot of rise and fall in the grade line, and the cost resulting from an increase in the ruling grade. Excluding fixed charges, but including all general expenses of operation, many of which are independent of the number of trains run, and even considerable variations in the physical characteristics of the track or motive power, or amount of traffic, the average cost of running one train mile in the United States is about \$1.18, having increased about \$0.22 since 1898, before which year the cost was practically constant, varying only a few cents for a number of years. Heavy freight trains cost from \$1.20 to \$1.80 or more per train mile, averaging about \$1.40, while passenger trains cost from \$0.75 or less, to as much as heavy freight trains, averaging about \$1.10 per train mile. The cause of the increase in cost is partly due to an increase in the weight of trains of both classes, and the increased elegance and speed of fast passenger trains. Operating expense is divided into four general items, each made up of a multitude of minor items for which reference may be had to the Reports of the Interstate Commerce Commission. The four general items with their several contributions to the train mile cost are:

Maintenance of way and works.....	\$0.26
Maintenance of equipment.....	0.225
Conducting transportation.....	0.65
General expenses.....	0.045
Total	\$1.18

From the detail items above referred to the cost of operating a train unit of distance, curvature, and rise and fall, may be approximated. Based on a train mile cost of \$1.00, these costs will be as an average for the United States about as follows: A train degree of curvature, \$0.0006; a train foot of rise and fall, from nothing to \$0.005, depending on the rate of the grade on which the rise occurs; a train foot of distance, \$0.0004; a train mile of distance from \$0.35 to \$0.90, according to the distance. If it is estimated or known that the train mile cost on any particular road is \$1.40 then the foregoing values should be multiplied by 1.4. Only heavy passenger and maximum freight trains should be considered in comparing different ruling grades, but all trains are affected by curvature, rise and fall, and distance.

Railway Revenue is a matter of importance to the railway engineer, for he must not plan a line of light traffic on so expensive a scale as one of heavy traffic. He can not spend so much to secure low grades for a line that

will probably run one or two or five trains a day as for one that will probably run 10 to 50 trains daily. For the purpose of design, the probable business is best estimated by the number of daily trains, but for the purpose of reporting on the desirability of a proposed new line, the estimate must indicate the probable revenue in money. In either case the only method of making a rational estimate is to compare the producing character of the territory to be traversed, with that of some similar territory already served by a railway, and to note the revenue of that railway. To compare population is not enough; the nature of the industries to be served, or that are likely to soon follow the construction of the road, must be considered.

Railway Location consists in selecting the general route between two adopted termini, and the detail work of so fitting the line to the ground along the adopted route by judicious curvature and grades that the cost of construction shall be an economic minimum. This may be the ultimate practicable minimum, but will not ordinarily be so. The effort of the locating engineer is to so design the alignment and grades that the net difference between revenue and the sum of operating expense and interest on first cost shall be a maximum. This work requires the greatest skill and judgment of any branch of railway design. The field work of fitting the line to the ground involves ordinary surveying methods. The surveys, after a reconnaissance which determines the general route, are two, the preliminary survey and the location survey. Practice has varied as to the methods of doing the detail work, but in general the preliminary survey is a topographical survey of a belt from 200 feet to 1,000 feet wide, within which the located line will lie, furnishing a map on which a centre line is planned to fit the ground as represented on the map, and the location survey consists in placing the line, thus designed, on the ground. Two maps are always made on a location survey, one showing the horizontal alignment known as the map, another showing the vertical alignment, the grades, known as the profile. The profile shows both the undulations of the natural ground surface and the undulations of the surface along the centre line as it will be when the road is graded. Generally an effort is made to so draw the grade line on the profile that there shall be as much of the natural surface above it as is below it, thus making the portion to be cut away equal the portion to be built up by embankment. This is generally economy, but as cuts are troublesome to drain, and to keep clear from snow in northern latitudes, a road is laid out in embankment so far as is economically possible. The most important item in railway construction, after providing the necessary strength to carry the trains, is drainage. When a cut or excavation lies across the general direction of the prevailing winter winds, it is likely to collect drifts. These are sometimes prevented by building open board fences parallel with, and some distance from, the cut, causing the drift to form outside the cut. In mountainous districts subject to heavy snow drifts, the track is sometimes protected by wooden sheds entirely covering it. Many miles of such sheds occur on the Central Pacific division of

the Southern Pacific Railroad through the Sierra Nevada Mountains, and on the Canadian Pacific Railroad. These snowsheds are very costly to maintain, requiring constant watchfulness to prevent fire, and the maintenance of fire fighting apparatus ready at all times. In determining the economic grades and curvature to be used, the locating engineer applies his knowledge of the facts and principles mentioned in the preceding paragraphs of this article. He determines how much he may spend to avoid a degree of curvature, how much to avoid a foot rise in the grade line, how much to shorten the line a foot or a mile, and how much to reduce the ruling grade below that which seems to give the lowest first cost; he determines where pusher grades may be introduced to advantage, and where velocity may be counted on to assist in surmounting some steep short grade that low first cost suggests. After the location is completed, and sometimes while it is yet in progress, the work of construction begins. Before this, details of rail section, cross ties, roadbed, etc., must be determined.

Railway Right of Way is the name given to the strip of land secured by the railway company for its use in building and maintaining its road. In the United States this strip is usually 100 feet wide, with additional ground for stations, shops and yards, and extra width along the line where the construction work is so heavy as to require it. Where an embankment is so high, or an excavation so deep that the base width of the one or the top width of the other is more than 100 feet, a retaining wall must be built or additional width of right of way secured. In cities it is generally advisable to build the walls, but in the country economy will be secured by buying extra right of way.

Railway Roadbed, the top of which is known as sub-grade, is from 14 feet to 18 feet wide where the road is in embankment, and from 20 feet to 26 feet wide where in excavation, for single track roads. The extra width in excavations is to provide room for drainage ditches on each side of the track. The side slopes of the embankments are usually one and one half horizontal to one vertical, which is about the angle at which ordinary earth will stand. Rock slopes may be made vertical in excavation and at 45 degrees, one to one, in embankment. Earth slopes are sometimes taken out in excavation at one to one, but they do not long stand at this slope, and the slight economy obtained in first cost is at the expense of additional cost of maintenance in keeping the ditches open.

Railway Ballast is the material in which the cross-ties are imbedded, and which serves the purpose of distributing the load on the ties over the roadbed, holding the track in place, and providing drainage for the track. The requirements for good ballast are that it shall be durable, shall yield no dust, shall be firm and porous. Fine broken stone or gravel make excellent ballast. Other materials used are furnace slag, cinders, burnt clay, and ordinary earth. In value these are about in the order given. For light traffic roads there should be not less than six inches of ballast under the ties, and for the heaviest traffic there need not be more than 16 inches. If the ballast is quite porous, as broken stone, it is carried up to the top of the tie

throughout its length and a little beyond the ends, and then sloped off to the roadbed, but if it is less porous, as compact sandy or loamy gravel, it is carried up to the top of the tie, or 3 or 4 inches above it, in the middle, from where it is sloped down to the bottom of the tie at its ends, and then to the roadbed.

Railway Cross-ties are usually of wood. A few steel ties are in use, and concrete steel ties are in experimental use. A hard wood, not quickly rotted by exposure, is desirable for a wooden tie. Oak and Southern pine are much used. Chestnut, cedar, redwood, bois d'arc, Douglas fir, and other woods, are used in localities where they are readily obtainable. Untreated with preservative, railway ties of good quality will last from seven to eight years, and in the alkali soils of the Western table-lands much longer. Comparatively poor soft wood ties, preserved by Burnettizing, the Wellhouse process, or creosoting, will last from 12 to 15 years or longer, and are much more economical than hard wood ties untreated. Probably not far from 100,000,000 cross-ties are used in the United States annually. The common size is six inches deep, eight inches wide, and eight feet long. Some are larger, and a few smaller.

Railway Rail designing was formerly a matter occupying considerable attention, and many forms were devised and used. The best form is still undetermined and under consideration by eminent railway engineers, but, with a few notable exceptions, American roads use exclusively what is known as the American Society of Civil Engineers' section, and modern designing consists simply in determining the weight to be used, and the chemical composition and physical treatment of the metal. Rails are known by the weight per lineal yard of one rail. A 60 pound rail weighs 60 pounds per lineal yard and has about 6 square inches in its cross section. The rail is divided into head, web and flange; and in the Am. Soc. C. E. section, 42 per cent of the section is in the head, 21 per cent in the web, and 37 per cent in the flange whatever the weight. The principal features of this section are the proportions of the metal in the three parts, the equality of total height and base width, the vertical sides of the head, some engineers advocating heads widening downward, and the small radius curves for the upper corners of the head. The section has proven well adapted to rails of less than 80 pounds per yard, but not so well adapted to heavier sections, the reason generally assigned being that the disproportion of thickness of head and flange makes impossible continued rolling at low temperature, which is said to harden the head and make it more durable. A section designed by P. H. Dudley for the New York Central Railroad overcomes this difficulty to some extent. Other types of rail are the Sayre, designed by R. H. Sayre for the Lehigh Valley Railroad, and the Sandberg type used somewhat in Europe. The standard type of rail in Great Britain is known as a bull head rail. It has two heads instead of head and flange, and is carried in cast iron chairs in which it is fastened by wedges. It was originally designed to be reversible, but it was found that by the time the head in use was worn the head in the chair had become so

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battered that it could not be used. The head in the chair is now rolled only large enough to provide the necessary bearing and wedging space. Rails are generally 30 feet long, a few of each lot being one or two feet shorter. There is a tendency to increase the length of the rail in order to lessen the number of joints, and a good many 33 feet rails are in service, some 45 feet, and a few 60 feet. Heavy street railway rails are almost always rolled 60 feet long.

Rail Jointing is as yet an unsolved problem. The object to be attained is to make the track at the joint as strong, as rigid, and as flexible as other parts of the track, in short, to make the jointed track act as a continuous track. There are two types of joints, known as supported and suspended joints. In the first the abutting ends of adjacent rails are on a tie, in the second between two ties. What is known as a bridge joint is a suspended joint in which a bar or plate of metal resting on the ties adjacent to the joint supports the rail ends. Common forms of splice bars, or joints, are the ordinary angle bar splice, the continuous rail joint, the Weber joint, and two modifications of the angle bar splice, known as the Bonzano, and the 100 per cent joint. Rails are fastened to the ties by hook headed spikes. Sometimes plates known as tie plates are used between the rail and the tie, to save wear on the tie and to form a lateral brace for the rail. Rail braces are used on curves, to brace the outer rail against the pressure of the wheels, and at switches.

Switches are devices by which a train is enabled to leave one track or enter another. They consist essentially of two movable rails called switch rails, which may be set to guide the wheels to the main track or to the turnout, and a frog, which permits the flange of the wheels to cross the rail of the main track where it is crossed by the outer rail of the turnout curve. There are various kinds of safety switches and frogs, devised in general to provide an unbroken main track.

Side Tracks for passing trains must be built along single track roads at intervals depending on the traffic. They may be long enough to hold from one to four trains. The maximum length of a train is not the same on all roads nor on all divisions of one road because of differences in ruling grade and locomotive power. Lengths of side tracks will differ accordingly. It is hardly practicable on single track roads to handle trains of more than 65 to 70 cars. Such trains will require about a half mile of siding per train. Double track roads require sidings to permit fast trains to pass slow trains. Even four track roads require occasional passing sidings, and all roads require sidings at stations for handling freight.

Railway Yard is the term applied to the space occupied by a railway at a station. At principal stations, yard design, meaning the planning of the arrangement of the side tracks in the yard, is a matter of great importance, requiring experience and judgment. A design is usually the result of the combined efforts of the Chief Engineer, the Master Mechanic and the General Superintendent. Beside the necessary shop and roundhouse tracks, and tracks for the storage of cars needing repairs, or temporarily out of service, each yard will have two distinct sets of

tracks, one for freight in each direction. Each set will have its incoming storage tracks, its classification tracks, on which the mixed freight of an incoming train is sorted according to its class, whether live stock, perishable goods, or other freight, and whether through or local, and its outgoing storage tracks on which the trains are made up anew for forwarding. Yards should be designed to make the movement of freight through them continuous. There are three methods of handling the cars, known as "push and pull," "poling" and "gravity." By the first a shifting or switch engine is coupled on the rear of a newly arrived train, pushes it ahead while a trainman uncouples the first lot of cars, called a cut, for some classification track, stops as suddenly as possible, when sufficient speed has been attained to send the cut to its proper place, pulls the remainder of the train back for a new start, and again pushes it forward, sending a second cut ahead, and so on till the whole train is distributed. The severe treatment of the cars, and the considerable total distance traveled by the engine will be apparent. By the second method, the switching engine runs on a track alongside the train to be distributed, the first cut is uncoupled, a pole is placed against the rear of the rear car of the cut and the forward end of the engine, which then pushes the cut ahead till it has attained sufficient velocity to send it to its proper place, and then returns for a second cut and so on. The lessened wear on the cars will be evident. By the third method a hump or hill is made in the track up which the engine pushes the train till the first cut is ready to run down the other side, which it is permitted to do, the incline giving it sufficient speed to carry it to its proper classification track. The first cut is followed by the second and so on. The cars are not severely used, and the engine travels simply the length of the train. Such a gravity yard furnishes the most economical method of distributing cars. If the road is a double track road, the main tracks should lie wholly without the yard, one track on each side, to avoid the necessity of any crossing of main tracks at any time. A single track road should lie on one side of the yard, the two sections of which may lap. A car once received from a main track should not touch it again till made up in a train to go forward. Comparatively few yards are well designed, having grown from small beginnings, but many new ones are being well laid out, and some old ones remodeled to conform to the requirements of increased business. Tracks in yards and sidings constitute more than one fifth of the total trackage of the United States.

Water Supply stations on busy lines occur about once in five miles and are rarely farther than 10 miles apart. In cities water is usually taken from the public supplies through suitable stand pipes or track cranes. Between cities it may be obtained from large wells, from near by streams, lakes or ponds, or from specially constructed reservoirs. An elevated wooden tank holding about 50,000 gallons or less is usually constructed at each water station. The height is sufficient to permit running water rapidly to the engine tender tank. A few roads running heavy fast passenger trains maintain track tanks, which are steel troughs about a quarter of a mile long in the centre of the track. These

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troughs are kept full of water by a near by pumping station, which also supplies steam and circulation to prevent freezing in winter. Water is taken by the locomotive without stopping. A scoop under the tender is lowered into the water at the beginning of the trough, and the water is forced up into the tender tank by the rapid forward movement of the locomotive. These tanks are expensive luxuries, necessary only to long distance high speed travel. In the arid districts of the West, water supply is a serious problem, solved often by the use of water trains conveying water from the nearest source to points where it must be on hand, but is not to be found. Water must be of good quality for steam making, and not infrequently is brought several miles in pipes because local water at a station is unfit for use in boilers. Various water purifying and softening processes are also in use. Water is supplied to the tanks by gravity from high storage reservoirs, or by pumps actuated by wind mills, steam, gas, or oil, engines. The cost of water supply amounts to about $\frac{3}{8}$ of one per cent of the total cost of railway operation, or about $\frac{3}{4}$ per cent train mile.

References.—For more complete information concerning railway location, construction, and maintenance, consult Wellington, 'Economic Theory of Railway Location'; Tratman, 'Railway Track and Track Work'; Camp, 'Notes on Track'; Gillette, 'Earthwork and Its Cost'; Webb, 'Railroad Construction.' Interstate Commerce Commission Reports, and Poor, 'Manual of Railroads,' both annual publications, give data concerning cost, expenses, revenue, etc.

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Railway Freight Car Mileage in the United States. The number of miles run daily, on the average, by freight cars is an indication of their usefulness and money-earning capacity. As the freight earnings constitute 69.4 per cent. of the total earnings of railroads in the United States, it is most important to keep the cars moving, so that their mileage and their earnings will be as large as possible.

Freight car mileage is classified as loaded and empty. Usually two-thirds of the total mileage is made when the car is under load, and one-third when it is empty. Of course, only the loaded mileage produces earnings, the empty mileage being made in moving the car from point to point in seeking the load; naturally a constant effort is directed towards reducing this empty, nonproductive mileage.

Poor's Manual of the Railroads for 1905 gives the following figures:

Miles of railroad operated....	213,828 miles
Tons of freight moved.....	1,277,771,573 tons
Tons of freight moved one mile	173,628,034.040 ton miles
Freight cars.....	1,728,903 cars
Total mileage of freight cars..	14,353,650.056 car miles
Freight earnings.....	\$1,374,102,275
Total earnings.....	\$1,977,638,713
Average distance each ton is hauled	136 miles
Average number of ton miles per freight train mile....	320 ton miles

From these figures it is found that on an average each freight car earned \$795 yearly; that it moved 8302 miles, or made that many car miles; that on the average it moved daily 22.7

miles; that during the year it carried 739 tons of freight, or 100,426 tons of freight one mile; and that there are 8.1 freight cars for each mile of railroad.

The average mileage made by freight cars is increased by long haul freight; by the prompt movement of freight after it is loaded; by a large percentage of high grade perishable stock or refrigerator car freight, which, necessarily, has to move promptly; by proper freight tracks and yards, so that the freight traffic is not delayed by the passenger traffic, or by lack of handling facilities; by the strict collection of charges for car service, so that cars are loaded and unloaded promptly; by not overloading freight trains; by a high daily rental paid for the use of cars in preference to a mileage payment; by keeping the cars and power in good repair; and by many other phases of good operation.

The mileage is influenced unfavorably by a short average freight haul; by a large percentage of low grade or slow moving freight, such as coal, which is often allowed an extra time for unloading before a charge is made for the use of the car; by poor track and yard facilities; by failure to charge and collect car service, thus allowing cars to stand under load an unduly long time; by overloading freight trains, causing delay on the road; by slow movement of freight after it is loaded; by a low mileage or day rate for payment for the use of cars; by equipment in poor condition; and many other phases of poor operation.

Naturally refrigerator cars loaded with perishable freight, which move long distances and must necessarily move promptly, make the greatest mileage, while coal, flat and gondola cars loaded with slow moving freight make the poorest.

The average mileage made with freight cars on the different roads varies from as low as ten miles to as high as 35 or 40 miles daily. The figure of 22.7 miles per car per day, which is the average made by all of the roads of the United States, appears to be very low; but then it must be remembered that the average haul is only 136 miles. Applying the daily rate of 22.7 miles to 136, we find that it gives an average of six days as the period between loading, or the time required for the round trip. When it is remembered that included in this figure of six days is the time required to load and unload the car, move it to obtain a new loading, and repair it when repairs are needed, the figure does not appear so bad. Car Service Associations usually allow two days free time for either loading or unloading a car, before a penalty is charged for the use of the car, and if one day beyond the four thus taken up be needed to place the car for its next load, it only leaves one day in which the car must be moved, and repaired when it needs repairs.

This illustration is given to bring out strongly the point that during the greater part of the time freight cars are occupied in the loading or unloading, or by waiting for a load; that only during a small part of the time is a car actually being moved. It shows the great necessity for quickening the time required for loading and unloading, and, of course, indirectly shows the necessity for car service associations to make and collect a charge for the use of cars

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when too much time is taken in either loading or unloading them. That is, the way to make the greatest gain in freight car mileage is by reducing the time a car is not moving.

The average length of freight haul per ton, as has been mentioned before, greatly affects the mileage made by the cars. Poor's Manual for 1905 gives the following figures as to the average freight haul per ton, which show much variation for different parts of the country:

	MILES.
New England States.....	86
Middle States.....	109
Central Northern States.....	141
Gulf and Mississippi Valley States.....	143
Southeastern States.....	192
Northwestern States.....	209
Pacific States.....	213

Naturally, the New England roads cannot make as good average mileage with their cars as the roads in the Pacific States.

The following are some of the important points watched by many railroads in order to increase the mileage made by freight cars:

Monthly statements are made showing the mileage made by freight cars of the various kinds on each Superintendent's division. These statements give comparison with preceding periods, and with the performance on each other division of the system. Thus, the statement at once shows the part of the system where the poorest performance of the cars is being made, and attention is naturally directed to bettering the conditions at this point.

An effort is made to put as much business as possible in the through trains that will run long distances without switching in intermediate yards. Thus, the cars move continuously for long periods.

At all points where business originates, it is necessary to hold empty cars in order to provide for the business. A number of men are constantly employed in watching them, to see that no more than necessary are kept on hand.

At terminals the number of cars to be unloaded is carefully watched, so that, in case they accumulate faster than they can be unloaded, arrangements are made by embargo, or by reduction of the supply of empty cars at the loading point, to avoid an accumulation of loads at the unloading terminal.

An increase of ten per cent. in the mileage made by freight cars is equivalent to building that much more equipment. The building of new equipment is frequently made unnecessary by increasing the mileage of existing equipment.

C. S. SIMS,

Assistant to the President, Erie Railroad Company.

Railway Heavy Freight Trains. The weight of freight trains in the United States has increased enormously within the last 10 years as may be seen by the following table, which shows the increases on a few of the most important roads in various sections of the country:

RAILROADS.	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Lehigh Valley				412	424	448	467	464	486	486
New York Central			290	320	361	398	392	387	421	419
Pennsylvania					470	478	481	518	527	501
Louisville & Nashville			179	194	216	236	222	231	231	234
Norfolk & Western			325	355	384	435	452	476	486	488
Chesapeake & Ohio		325	352	379	450	500	533	538	538	538
Southern		162	173	176	188	203	222	226	218	225
Illinois Central			194	191	209	222	275	325	335	339
Chicago & Northwestern		141	152	194	218	236	232	250	232	225
Chicago, Milwaukee & St. Paul	152	167	167	175	187	205	263	285	281	280
Lake Shore & Michigan Southern	318	322	321	352	427	455	531	577	615	588
Southern Pacific				220	226	240	254	261	267	275
Northern Pacific			220	313	336	391	381	401	384	403
Great Northern		256	281	316	336	357	381	418	447	447

In the Car Record Office at intervals of every five days the records of movement and location of cars are gone over, and the Superintendent of Car Service writes to the Agent, or Yardmaster at whose station or yard a car has been located for an unduly long time, inquiring as to the cause and suggesting the movement of the car.

Once during each month a statement is made, showing all cars which have not moved for a period of five days or more on each Superintendent's division. This statement is made so that it compares with the preceding period, and with each division. It is a constant reminder of the necessity of moving the cars,—an effort naturally being made to have each succeeding statement show fewer old cars.

Card waybills under which a car is moved are often stamped with the date of arrival of the car at any point. Thus, by looking over the card waybills is ascertained the length of time any car has been at any point, and the old cars can readily be checked.

This table gives the average weight of train in tons of 2,000 pounds hauled by the roads during this period. In some cases this is revenue tonnage, and in others total tonnage, but as the same unit is used for the figures of any one road, the proportionate increase can be easily discerned. As a rule roads lying east of the Mississippi river have not increased the weight of train is as great a proportion as the other sections, but in 1899 the trains of these eastern roads were generally heavier than those of the west, so that there was less opportunity for increase. It is also of interest to note that there has been comparatively little increase from 1902 to 1904, but there have been some very great increases within the 10-year period as, for instance, will be seen by referring to the Lake Shore record, which averaged 318 tons in 1895, and 615 tons in 1903, or nearly double, and C. & St. P. has accomplished nearly the same proportion of increase, but even now its train load is not as great as the Lake Shore's was 10 years ago. This is accounted for by the

RAILWAY HEAVY FREIGHT TRAINS

fact that the latter road is nearly straight, with light grades, while the former has hills that are possibly three times as steep.

We must not confuse, however, the train loads given in the table with what is actually hauled by the locomotives, as the Lake Shore road has engines which can haul 3,000 tons or more back of the tender. The figures are the average train loads for main line and branches, and, moreover, do not include the weight of the cars themselves, which may run from one half to one and one half times the load, depending upon whether it is heavy or bulky. One of the transcontinental lines recently grouped its locomotives so that trains of from 1,350 to 2,600 tons could be hauled westbound, that is, the load back of the tender lay between those limits for different portions of the line, the engines being distributed according to the grades, so that a constant train load could be taken as far as possible. The first 450 miles were of undulating profile, having .8 per cent. grades and 1,500 tons were pulled over this portion. Beyond this the grades were lighter, and with helpers at critical points the train load was 2,400 tons for a distance 600 miles. The following 500 miles had very heavy mountain grades, and even with three large engines the load was reduced to 1,500 tons. One hundred miles of descending grades permitted one en-

noticed that generally the cost has risen in this period, while it fell before; but we also see that the greatest increase in tonnage per train mile was made in the previous five years.

Examine, for instance, the Northern Pacific record, where the cost dropped from .70 to .47 between 1897 and 1900, and the train load increased from 230 to 391 tons, whereas, from 1900 to 1904 the load has only increased 12 tons (from 391 to 403), and the cost is about the same, viz., .46 cents. So, also, for the C. M. & St. P., the weight of train increased from 152 to 285 tons, and the cost dropped from 67 to 56 cents between 1895 to 1902, but since then the train load has decreased slightly and the cost has risen to .59. In this case also the lowest cost was accompanied by the heaviest train. The Illinois Central, C. & N. W., and Great Northern also show that the lowest cost corresponded to the years of heaviest train loads. Some of the other roads show a slight increase in cost in connection with a slight increase in weight of train, but this is due no doubt to heavier charges for labor and material.

In order to haul such trains much heavier locomotives are needed, and the following table gives the principal elements of the heaviest freight locomotives that were built during corresponding years as given in the engineering journals:

ITEMS.	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Total weight in tons.....	87.5	92.5	86.0	115.	110.	125.	105.	132.	142.	167.
Adhesive weight in tons.....	75.0	75.0	62.5	102.	92.5	112.	92.5	117.	117.	167.
Tractive force in pounds.....	38,000	38,000	26,000	53,000	50,000	64,000	49,000	62,000	63,000	70,000
Heating surface in square feet.....	2,300	2,900	2,900	3,300	3,500	3,800	3,600	5,400	4,800	5,600
Grate area.....	35	35	34	35	40	42	52	59	58	72

gine to take 2,600 tons, but beyond this additional mountain ranges required the tonnage to be cut in half to tidewater 600 miles further. Thus the train would be broken nine times in covering 2,300 miles of road, but the profile and available locomotives did not permit of a closer adjustment. This gives some idea of the diversity of conditions with which large systems have to contend.

The partial effect attributable to increase in weight of train is shown in the following table which gives the average cost of hauling one ton, one mile in cents, during the same period. It must be remembered that there are many other items besides the weight of train which effect this cost, as variation in price of materials and labor. These latter have increased considerably within the last five years, and it will be

Of course, the introduction of large locomotives when purchased in considerable numbers, will have an immediate effect upon the average train load, but even if the total power of the road has a 10 per cent. increase in large engines, the general average would be but slightly raised. The C. & N. W. found that in 30 years the average tractive force of its locomotives on its lines had increased 150 per cent, which would mean a corresponding increase in train load, but we find that in ten years alone this road has nearly doubled its weight of trains. This indicates that the increased size of locomotives is not alone responsible for heavier trains, and while double heading has made some increase there is no doubt but that the system of tonnage rating is responsible for a large proportion of the increase. When locomotives are

RAILROADS.	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Lehigh Valley.....		.43	.42	.35	.40	.42	.41	.41	.43	.40
New York Central.....				.39	.35	.35	.38	.42	.44	.48
Pennsylvania.....					.34	.36	.38	.40	.43	.42
Louisville & Nashville.....			.58	.54	.52	.54	.50	.51	.54	.55
Norfolk & Western.....			.33	.28	.27	.26	.28	.27	.29	.31
Chesapeake & Ohio.....	.28	.27	.24	.23	.23	.22	.24	.25	.....	.31
Southern.....	.68	.65	.64	.63	.64	.66	.66	.66	.70	.69
Illinois Central.....		.44	.44	.45	.45	.43	.41	.40	.39	.43
Chicago & North Western.....		.63	.60	.56	.54	.50	.51	.50	.55	.61
Chicago, Milwaukee & St. Paul.....	.67	.60	.61	.61	.59	.63	.57	.56	.58	.59
Lake Shore & Michigan Southern.....	.39	.37	.37	.34	.32	.33	.34	.38	.41	.42
Southern Pacific.....				.62	.62	.64	.64	.66	.68	.68
Northern Pacific.....			.70	.50	.50	.47	.48	.46	.47	.46
Great Northern.....		.51	.53	.44	.45	.46	.48	.42	.42	.46

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loaded by actual weight of train instead of by number of cars, as was formerly the practice, the full power of the engine can be utilized and heavier average trains can be hauled.

There are limits, however, which should be observed in this practice, and while some dispatchers thought that if a heavy train was good practice a heavier one would be still better, and loads were added until the engine could hardly ascend the maximum grades, it has been frequently demonstrated that it is not only impossible to obtain a large monthly freight movement per engine by such overloading but it is also usually a very expensive practice; that is that if we wish to obtain the greatest ton mileage from a locomotive during a period of time, and also operate at the lowest possible cost, we must usually attach a considerably lighter train than the maximum which could possibly be taken over the heavy grades.

The tractive force of simple locomotives at slow speeds (8 to 10 miles an hour) is taken as eight-tenths of the product of the boiler pressure in pounds per square inch, the square of the cylinder diameter in inches and the stroke of the piston in inches, divided by the diameter of the driving wheel in inches. This tractive force is at the rail and the weight upon the drivers must be at least four times as great as the tractive force. A train can be hauled when the resistance (including engine and tender as cars) does not exceed the tractive force.

The resistance must be figured for speed, grade and curvature and also for inertia when starting or accelerating trains. The speed resistance below 20 miles an hour can not be expressed by any regular rule, and amounts to about as follows: 5 miles an hour, 5 lbs. per ton; 10 miles an hour, $5\frac{1}{2}$ lbs. per ton; 15 miles an hour, 6 lbs. per ton, and at 20 miles an hour, 7 lbs. per ton. Above this speed the resistance in pounds per ton is generally taken as one-fourth of the speed in miles per hour plus two pounds: at 20 miles an hour this also gives 7 lbs. per ton; and the weight of the engine and tender must be included as well as the weight of the cars.

For the resistance due to grades we must know the amount of ascent either in feet per mile or in per cent of length. The resistance per ton will be .38 times the number of feet rise per mile of track, or 20 times the per cent of rise when stated as a percentage, that is, 20 pounds per ton for a 1 per cent grade. Curvature has a resistance of about .7 pounds per ton per degree of curvature, but it is probable that locomotives with long rigid wheel-base about double these figures.

It requires a great deal of power to accelerate a train, that is to bring it to a given speed from rest, or from a lower speed to a higher speed. Including the rotative inertia of the wheels and axles it is necessary to exert a force in pounds per ton equivalent to 70 times the square of the speed in miles per hour divided by the distance in feet in which the acceleration is to be effected, or 95.6 times the speed in miles per hour divided by the time in seconds, if time instead of distance be considered in the calculations. If the speed is to be increased from a lower one to a higher one then in the first case we should substitute the difference between the squares of the speeds and in the

latter case the difference between the lower and higher speeds. In all cases the weight of the engine and tender must be included in making up the total resistance and this total must not exceed the tractive force as determined above.

The relative weight of cars and their loads also enters into the problem. It has been found by experiment that empty cars on a level track require a much greater force per ton to haul them than when heavily loaded, this being due no doubt to the fact that the wheel and axle friction has a smaller total weight into which to be divided. As a matter of fact it was necessary to allow about 30 per cent on a level for empty cars over a similar total tonnage of loaded cars. The resistance of a train can be considered as depending both upon the number of cars and the total weight and it has been suggested that this total resistance might be taken as 3.5 times the weight of the train in tons of 2,000 lbs. plus 50 times the number of cars in the train, the resistance so figured being in pounds at the tender drawbar, and on a straight level track with speeds not exceeding 10 miles an hour. From this rule we find that a car weighing $16\frac{2}{3}$ tons would have a resistance of 6.5 lbs. per ton, one of $33\frac{1}{3}$ tons a resistance of 5 lbs. per ton and one of 50 tons total weight a resistance of only 4.5 lbs. per ton.

Thus we see that the advent of 50 ton cars has the effect of reducing the train resistance not only by their lighter weight per unit of capacity but also by the fact that heavier loads are carried on an equal number of wheels. Ten years ago there were few cars of greater capacity than 30 tons, and now 50 tons of coal and ore are quite common. These high capacity cars generally have steel frames and weigh little more empty than the 30 ton cars with wooden frames of previous years. The draft gear is of course very much more heavily strained than formerly, as the first car in the train must take the total pull of the one or more locomotives at the head of the train; this has led to the introduction of friction draft gears instead of entire dependence upon springs. The steel sills are much better able to stand the heavy pulling and buffing strains than the old time wooden sills and while the cost is considerably greater (about \$200 or \$300 per car) the evidence at this time indicates a much longer life and usefulness for the steel cars and a decreased cost of repairs.

G. R. HENDERSON,

Author 'Locomotive Operation.'

Railway Heavy Passenger Trains. Like everything else in railroading the heavy passenger train of to-day is a creature of evolution. Heavy long-distance trains were an impossibility before the development of safety appliances and the inventions of Westinghouse and Pullman and before the consolidation of connecting lines had proceeded to a sufficient extent to permit of the passage of trains for many hundreds of miles over tracks under one management. Friendly co-operation between connecting lines, indeed, is the distinguishing feature of these famous trains.

The "Flying Yankee," one of the first of these trains, beginning service in 1884 between Saint John and Boston, is still in service. It consists regularly of ten cars, all vestibuled, and uses the tracks of three railroad companies to

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accomplish its daily journey. The Cleveland, Cincinnati, Chicago and St. Louis, better known as the Big Four Route, sends its Florida Special from Chicago and Cleveland to Saint Augustine, and claims patronage on the ground that the traveler is but one night out from Chicago. This train is taken up by the Queen and Crescent Route at Cincinnati, the Southern Railway at Chattanooga, and the Florida East Coast Railway at Jacksonville. Another heavy long-distance train is the Washington and Southwestern Limited of the Southern Railway. It has been operated in daily service for fifteen years. Using the Pennsylvania Railroad from New York to Washington, the Southern Railway takes the train in charge to Atlanta over its own tracks. Here the Atlanta and West Point and the Western Railway of Alabama are called into service for the journey to Montgomery, and from this point to its final stopping place—New Orleans—the Louisville and Nashville is used. The equipment is exclusively of high grade, heavy Pullman standard, including club and smoking cars, drawing-room sleeping cars and observation-library cars, besides a heavy dining car.

A notable instance of co-operation in through service of heavy trains is furnished by the Missouri Pacific, the Iron Mountain, the Texas and Pacific, the International and Great Northern, and the National Lines of Mexico, in the recent establishment of the Mexico-Saint Louis Special. This train leaves Saint Louis semi-weekly on Tuesdays and Fridays, and occupies fifty-five hours in the journey to the City of Mexico. No higher grade of service has ever been attained between this country and Mexico than is that of this solid vestibuled train. See RAILWAY SYSTEMS and RAILWAY TRAFFIC.

Railway Hospitals, in the United States. When the question of hospital relief of the railway employees of this country is compared with other countries, particularly the European, the investigator will be surprised and shocked to find how inadequate and inferior are the provisions made in the United States, in comparison to those in Russia, Germany, France, England and other countries. W. H. Ballou writing on this subject, says:

It is to be regretted that the story of the injured American railway employee is not wholly flattering to this nation, and that to tell it truthfully, even with its hopeful features, followed by the story of the Russian railway employee, must necessarily redound to the glory of Russia. Incapacitate a Russian railroad man, however high or humble, and he and his family become the wards of the government so long as they live. The American railway employee often has only his brotherhood or labor organization on which he can rely somewhat in case of death or accident. Apparently there is nothing for his family except his small savings, if any, and his small share of a brotherhood or association insurance fund, excepting on a few lines. In case of his death, his family must practically become their own bread winners. If he is maimed, he is probably taken to the nearest public hospital, if in a populous district, or he may be thrown on the liberality of the nearest farm-house and country doctor. If incapacitated for life he often becomes an object of charity; or if arrangements can be made for his care at a very small cost his brotherhood and the several organizations to which he belongs assess themselves for his maintenance. What to do with incapacitated employees has ever been a problem for the railway man.

It cannot be stated that this subject has not received thorough investigation. No subject in connection with railway management has been

any more thoroughly and intellectually studied. The conditions existing in this country are so radically different from those existing in European countries, as to make it a problem in political economy far-reaching and excessively difficult of solution. Charles Francis Adams, Dr. W. T. Bernard, W. T. Kirkman, Samuel R. Barry, K. H. Wade, R. F. Smith, and a host of others, have studied this question and written extensively. It is to be deplored that neither productive co-operation, nor profit-sharing plans have demonstrated their practicability and magnificent effects in influencing industrial interests. It is reasonable to believe that all earnest, sensible men, be they the chief executives of large industries or not, would hail with pleasure any solution to the labor question.

It will be manifest to the most casual investigator that the advancement in relief measures in this country is slow and halting, but while various forms of relief measures are far behind the European countries, it is an undoubted fact that no form of labor as a mass is as highly paid as railway labor is in this country; the wages paid to the railway employee would be sumptuous pay for many professional men in Europe. The Interstate Commerce Commission states that 60 out of 350 railway companies have an insurance or guaranty fund, or hospital fund, or relief association affording aid in various degrees to employees, or both co-operating on some mutual plan, 13 companies make distinct provision for superannuated employees when disabled by accident; 125 companies give preference to employment for service for which they are qualified, or provide in divers ways and degrees during disability at the companies' expense; 225 do not.

The hospital departments differ from relief associations in the fact that the relief departments are essentially insurance companies insuring the sick and injured employees for loss of time in sickness, and injury and death benefits to family. The rate of assessments in relief associations ranges from 75 cents to \$3.75 a month. We will name only the best form of relief associations, as being those of the Pennsylvania Railroad Company, the Baltimore & Ohio, the Chicago, Burlington & Quincy, and the Delaware, Lackawanna & Western, while the Northern Pacific Company has a mixed hospital department and relief association. The Pennsylvania Railroad Relief Association and the Baltimore & Ohio have had pension features operative. Hospital departments differ from relief associations in the fact that an employee signing the application for membership in a relief association signs away his rights as a litigant for injuries received, and accepts in lieu thereof sick, injury, pension and death benefits. Membership in hospital departments have no connection with the future litigation of an injured employee. The average rate of assessments in hospital departments are 25c and 50c monthly. For the assessment the hospital department gives treatment for all diseases (except those arising from vicious acts), and for all injuries. The monthly assessment is contributed for the purpose of sustaining the hospital department. All compensations for injuries received are settled for by the companies according to legal merit in each case through claim and legal departments.

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Hospital departments upon railroads in the United States were established as a matter of necessity and economy, as railways were built and extended over trackless plains or among tortuous passes and cañons of mountain ranges, in thinly peopled regions, and it was at times utterly impossible to obtain medical relief. It soon became demonstrated that the indiscriminate employment of medical men whose sympathy and warped judgment when treating either injured railway passengers or employees made prejudiced and unjust witnesses in case of litigation, and thus became extravagant factors. Again, it was shown that a trained corps of experienced surgeons when employed by the railway companies were enabled (owing to extended experience and consequent education), to be more competent to obtain better results in the treatment of these (railway) injuries than the inexperienced and imperfectly trained. The first hospital department organized upon any railway in the United States possessing the characteristics of hospital department as now organized, was developed by the late Col. A. N. Towne, second vice-president and general manager of the Southern Pacific Railway. This hospital department was organized in California in 1868, and was at first maintained by voluntary assessments, but this form of assessment not being self-sustaining, the assessments were made obligatory upon each and every employee of the Southern Pacific. It was not until 11 years after that the Missouri Pacific Company organized its hospital department, shortly after the late Jay Gould began the formation of the Missouri Pacific system. As each new road was added the hospital department extended over it. The Missouri Pacific system then included the Missouri Pacific Company and branches, the Missouri, Kansas & Texas, the Saint Louis, Iron Mountain & Southern, the Texas & Pacific, the International & Great Northern, the Wabash East and the Wabash West. Afterward the Atchison, Topeka & Santa Fé, the Gulf, Colorado & Santa Fé of Texas were started, and at the present time there are 17 companies having organized hospital departments, treating annually over 268,000 patients.

In the formation of hospital departments, the circular issued by the management of the railway constitutes the source and directions for collecting deductions to constitute a hospital fund. It is not necessary to give the rules in full, but the following will answer:

1. On wages earned of \$50.00 and over per month a deduction of 50 cents shall be made. On wages earned of under \$50.00, a deduction of 25 cents shall be made.
2. No deduction will be made when the amount earned is less than \$1.35 in any one month.
3. Any employee who may be taken sick shall be entitled to admission to the hospital upon presentation of certificate signed by his (or her) foreman, approved by the head of that department of the company's service.
4. Patients received at the hospitals and emergency stations will be provided by the institution with everything necessary to their careful and comfortable treatment, so long as they obey the rules established for their protection and require the professional service of a surgeon or physician.
5. Any employee receiving a certificate of disability, signed and approved as above, will be entitled to receive from the head of his department a pass to the hospital from any point on the line.

Local surgeons are appointed along the line ranging from 30 to 50 miles apart. All local

surgeons are under contract, and the fee bill for services is contained in the contract. The following explains the manner in which accidents are cared for:

INSTRUCTIONS TO EMPLOYEES AND OTHERS FOR THEIR GUIDANCE IN CASES OF ACCIDENT RESULTING IN PERSONAL INJURY.

1. All cases of accident where an employee or other person is injured, notify at once the chief surgeon of the same, and place the injured person in the care of the nearest division surgeon or local surgeon as soon as possible.
2. When the injured person is able to be moved take or send him to the nearest division surgeon or local surgeon in the direction in which the first train is going, notify the local surgeon by wire of his coming and the character of his injury.
3. In case the injured party cannot be moved, place him in the care of the nearest local agent, who will take charge of him, and notify at once the nearest division or local surgeon.
4. No surgical operation shall be performed until the arrival of the division surgeon or local surgeon, unless it may be required for the immediate safety of the patient.
5. In cases of accident, when a number of persons are injured, procure at once the services of competent surgeons in the immediate vicinity and give every attention and care to the wants of the injured. Notify division or local surgeon in each direction and the chief officers of the road by wire, giving particulars, number injured, and what is required for their relief.
6. Tramps, children, and other persons not employees, injured by their own carelessness, in jumping on or off trains, must be sent to their homes, or placed in charge of local relief authorities.
7. In case of injury resulting in death of party, notify coroner at once, and await the direction of the chief surgeon as regards disposition of remains.
8. Stretchers for the convenience of injured and sick are to be found on all train baggage cars, and at all points where local surgeons are stationed.

INSTRUCTIONS IN CASE OF SICK EMPLOYEES.

1. Sick employees desiring hospital benefits must procure from their foreman certificates (furnished them for this purpose) which when presented at either of the above-mentioned hospitals, will entitle them to admission or treatment, as they may desire, except chronic disease and those arising from vicious acts.
2. Employees desiring medicine can apply for the same at hospital and emergency stations. These applications for medicine must be signed by the foreman, otherwise they will not receive attention.
3. Passes will be supplied all employees by heads of departments for transportation to the various hospitals. In case of emergency when delay would arise in procuring a pass, notify chief surgeon by wire, and transportation will be arranged at once.
4. Applications for medicines should be addressed to chief surgeon.

The hospital fund being now established, chief surgeon, division surgeons and local surgeons appointed, local surgeons' reports furnished and various forms needed supplied. In the start of any hospital department the railway company supplies the hospital; besides supplying transportation to and from the hospital or hospitals, and emergency stations. The company collects and audits and has general supervision of the hospital fund. It assumes all the responsibility in case of an inadequacy of the fund to meet all obligations brought against the hospital department. Besides having division and local surgeons in hospital department, each hospital in the department has a competent corps of surgeons, from two to five hospital internes, all necessary specialists, such as the oculist, the aurist, throat and lung specialist, the dermatologist, neurologist, and the bacteriologist. The specialists employed upon the hospital staff are generally medical men of high reputation. Prescriptions are filled and sent out to any employee making proper application. Trusses, elastic bandages, various minor prothetic agents, are sent when requested. Large systems like the

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Atchison, Topeka & Santa Fé, the Southern Pacific, and the Missouri Pacific, having more than one hospital situated in different regions of country, are enabled to make an interchange of patients where climate may be beneficial. The consumptives sent to climates having favorable surroundings and proper altitude. Employees suffering from catarrhal and rheumatic troubles are sent to hospitals built in the warm regions of the South. This interchange of patients cost the sick railway employee nothing but the small sum of money used in buying sustenance from one point to another. Where prominent watering places such as Hot Springs are on the line of road, local surgeons are stationed for the purpose of treating sick employees.

The benefits of the hospital department having broadened out in every direction for the benefit of the sick and injured employee, the most casual investigation will show that these departments are all well patronized. In the matter of sanitation and hygiene, these departments have been very efficient and useful, issuing from time to time circulars for the guidance of the employee during the prevalence of epidemic or endemic trouble; also in investigation of the sanitary condition of depots, shops, and section houses, and doubtful water supply. At this juncture a description of the manner in which the larger hospital departments and associations are administered, there being differences concerning the benefits obtained by the employee and the form of government controlling the collected hospital or association fund.

The Southern Pacific Hospital Department has one general hospital in San Francisco, Cal., costing \$160,000, besides having six division hospitals, and nine emergency stations. These hospitals and emergency stations in 1903 treated 58,220 patients; 3,395 were in-patients, the balance were out-patients. This department gives the following benefits: hospital treatment, medical and surgical outside of hospitals, medical and surgical dressings, artificial limbs and appliances, accommodations at railway and contract hospitals for dependent members' families. The government of the hospital fund is by the general officers and chief surgeon of the Southern Pacific Company.

The Missouri Pacific Hospital Department is governed by the vice-president, general manager and chief surgeon, and has one general hospital in Saint Louis, costing \$110,000, one division hospital, 12 emergency stations, with six contract hospitals. It has the following benefits: medical and surgical treatment at hospitals and emergency stations; supplies surgical dressings, prescriptions sent out on road, also supplies mechanical appliances, trusses, artificial eyes, and various minor prosthetic agents; carries out interchange of patients from one hospital to another, requiring climatic treatment for sick employees, issues when needed to the employee hygienic and sanitary circulars, and supplying coffin and shroud for dead employees. Total number of patients treated 42,084.—In-patients, 8,615; out-patients, 33,469.

The Atchison, Topeka & Santa Fé Hospital Association is governed by the Atchison, Topeka & Santa Fé employees, electing annually a board of control and the chief surgeon. This association has five new and modern hospitals; the Topeka hospital costing nearly \$100,000. All

of these hospitals are owned by the hospital association. There are two emergency stations at Denver and Chicago. It supplies surgical dressings, artificial limbs, trusses and mechanical appliances, medical treatment extended to employees along the line of railway and hospital benefits at all of the hospitals; likewise, interchange of patients for troubles benefited by climate. Total number of patients treated by this association: surgical cases, 4,898; medical cases, 34,273. Total from all sources, 39,171.

The Northern Pacific Beneficial Association of the Northern Pacific Company, is governed by Hospital board elected annually, and has two general hospitals, two division hospitals, and six emergency stations. It has essentially the same benefits as the Atchison, Topeka & Santa Fé Hospital Association and the Southern Pacific. It treated 33,375 patients during 1903.

The Wabash Employee Hospital Association of the Wabash Railroad Company, has three division hospitals and 11 emergency stations. The benefits are the same as the Missouri Pacific Hospital Department. It treated in 1903, 3,151 surgical cases, 22,865 medical cases; total, 26,016.

The Saint Louis & San Francisco Hospital Association, governed by Employees' Hospital Association, has one general hospital and 15 emergency stations. In 1903 it treated 11,573 medical patients, 4,852 surgical patients. Total treated, 16,425.

The Denver & Rio Grande Medical Department, governed by the Board of Employees. The benefits are the same as Missouri Pacific Railway Hospital Department. Has one general hospital, 12 emergency hospitals. It treated in 1903, from all sources, 15,581 cases.

The Saint Louis Southwestern Medical Department is governed by general officers and chief surgeon, and has two hospitals. The benefits are the same as the D. & R. G. It treated in 1903, from all sources, 13,809 patients.

The Missouri, Kansas & Texas Hospital Department is governed by the general officers and the chief surgeon, and has one general hospital and nine emergency hospitals. The benefits are the same as the Missouri Pacific Hospital Department. Treated in 1903, from all sources, 9,876 patients.

The Texas Midland Hospital Department, International & Great Northern Hospital Department, Gulf, Colorado & Santa Fé Hospital Association, and the Chesapeake & Ohio Hospital Department have eight hospitals, treating annually nearly 19,726 patients. The benefits are the same as Saint Louis & Southwestern. Hospital departments upon railways enable the employee belonging to these departments to obtain compensation for personal injuries and permanent disability far in excess of what the employee could possibly obtain when working upon a railway not having hospital department. Labor organizations predominate upon Western systems. Each branch of service has its own labor organization. Thus the engineer belongs to the Brotherhood of Locomotive Engineers; the conductor to the Order of Railway Conductors; the fireman to the Brotherhood of Locomotive Firemen; the brakeman and switchman belong to the Brotherhood of Railway Trainmen, etc. Each of these orders has its own insurance features, the orders aiming to become thoroughly

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protective, sustaining their members when in enforced idleness, ensures them against permanent disability, and members' families by payment of death benefits. Suppose that a locomotive engineer has been permanently disabled, he at the time of his permanent disability is employed upon a railway having a completely equipped hospital department. He is treated free of charge from a year to a year and a half and more, that is, until well. During the time the employee is disabled he is supplied with all necessary medical and surgical treatment, for which he has paid 50 cents a month, or \$6 a year, getting a return for this several hundred fold of that which he has contributed. Had this employee been compelled to pay for treatment, it can be readily seen what doctor, board, nurse and other bills would amount to. Perhaps this same workman has not accumulated in the interim of his labor enough means to stand the expense, still he receives this treatment in virtue of the fact that he has paid his assessment to the Hospital fund, which justly entitles him to the treatment received, and is in no sense dependent upon charity. Again, let it be understood, that this same injured man is a member of the relief feature of the association of the Brotherhood of Locomotive Engineers. He gets from this source from \$1,500 to \$4,500 for permanent disability. In addition to this there is left to him what he may get from the railway company for the settlement of his claim. If he has been provident, as a good many are, he may hold one or more policies from one of the regular accident insurance companies. The money he receives from his order enables him to take care of his family while he is laid up in process of treatment. It is not a remarkably infrequent thing for a permanently disabled employee to obtain from \$2,000 to \$10,000, and in addition thereto receive from the company employment such as he can do in his crippled condition. It will thus be seen that many seemingly harsh emergencies are successfully met, accorded the best of medical and surgical treatment, supplied with every element required, obtains means to support his family while not earning, and afterward frequently placed in a position where he is still competent to become a bread-winner, though in a disabled condition. In England many employees are contented with \$500 for permanent disability. With organized labor and a hospital department it is certainly in many instances a most perfect safeguard of the interests of the employee, not only immediate, but future.

It has been demonstrated that while the surgery of railways may in many respects resemble other violent forms of surgery still an extended experience is required in order to be enabled to accomplish the best results, so that it can be readily seen that the surgery of the present demands certain conditions which cannot be readily obtained outside of a hospital. So that, if the result is to be considered, whatever hardship may be imagined as far as treatment at a hospital is concerned, its benefits are worthy of the sacrifice. Secondly, owing to the excessive breadth of medicine, owing to the fact of its constant improvement, it is an utter impossibility for one man even to have a meagre knowledge of the entire field of medicine. Specialism has demonstrated that competency only comes from study and experience, and the results obtained

by specialism have been marked and pronounced. Hence, in well regulated hospital departments every necessary specialty is employed, the oculist, the aurist, the dermatologist, the throat and lung specialist, the neurologist, so that for the \$3 and \$6 a year the employee has the advantage of consulting and receiving treatment from all these various forms of specialties, without any additional expense. Surely this is broad enough when the small sum is considered, namely the \$3 and \$6 per year paid in assessments. Again, they enable the employee to be removed from unhealthy regions to more healthy ones. The management furnishes passes to and from any part of the line as deemed best by the surgeons in charge of its hospitals and emergency stations, and employees are thus brought to hospitals from malarial portions of the country to non-malarial, and it is possible for the humblest employee to change from bad to more healthy and salubrious climes. The hospital department is thus enabled to effect cures by the fact of this change which otherwise could not be accomplished; besides they are enabled to send the consumptive to climes better fitted for his treatment and care which a lack of means on the part of the employee would oftentimes debar. See HOSPITALS.

DR. W. B. OUTTEN,
Chief Surgeon Missouri Pacific Railway Company.

Railway Interchange Car-Service. Whenever traffic demands it, and physical and political connections allow it, cars are interchanged between railways. The arrangements under which these interchanges are made vary, but they are always intended in some sort to compensate the car owner for the use of his property and usually to secure its return. Some of these arrangements, therefore, are based upon the distance traveled by the car upon foreign rails, others upon the time the car is away from home, while others yet are "mixed systems" combining the bases of distance and time. It is to be noticed that where the interchanges are most general the arrangements are the simplest. Thus, in Europe where mixed systems prevail the interchange of freight cars is not so general as in North America where a simple system based on time is in effect. Again, in North America the interchange of passenger cars, which involves a prior agreement as to whether the basis of compensation shall be time or distance, is not so general as the interchange of freight cars, which is covered by this general and simple agreement. The agreements and arrangements covering the interchange of cars are made in some cases between two railways, in others by associations of railways, and in other cases by governments. Thus, on the continent of Europe interchanges are arranged by the government involved, in England by the Railroad Clearing House and in North America by the American Railway Association.

In Europe and Asia it is quite general to make a certain charge per mile for the use of foreign cars on the understanding that a certain time will be allowed for a journey of a certain length. If the car is delayed beyond the time allowed, a demurrage charge is imposed besides the mileage. The various systems in vogue are of a certain complication involving a separate calculation for each car, and in some cases more

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than one calculation. In America, on the other hand, the tendency has always been toward simplicity, even when this sacrificed more essential conditions. In the interchange of passenger cars the interest of the car owner has always been conserved, but in the interchange of freight cars, until a comparatively recent date, the interests of the car owner were sacrificed in the interest of a faulty simplicity. Since the middle of 1892, however, a marked improvement has been made, and the car owner is now sure of a certain compensation for every day his car is on a foreign railway.

The value and scarcity of passenger cars has always made railways conservative in their interchange. When two or more lines regularly interchange passenger cars in America in "through service" it has been quite general to equalize the mileage so far as may be by manipulation of equipment, so that the mileage balance could be made as small as possible, and this mileage balance has generally been settled on the basis recommended by the American Railway Association, which includes in its membership all of the prominent railways of North America. These mileage rates are as follows:

Coaches, etc.	Three cents per mile.
Baggage cars, etc.	One one-half cents per mile.

In cases where passenger cars are loaned temporarily it has been more usual to apply the "Per Diem" rates recommended by the same body, namely:

Coaches, etc.	\$5 per day.
Baggage cars, etc.	\$3 per day.

With freight cars the case is different. The American Railway Association having adopted a set of "Per Diem Rules Governing Settlement for the Use of Freight Cars," in April, 1902, the railways of North America, with few and unimportant exceptions, signed an agreement that they would abide by these rules for the space of one year and thereafter upon three months' notice. This agreement has now been in effect nearly two years with slight amendments in the rules, and there is every indication that the arrangement will be a permanent one. The claim is made, with some show of justice, that this agreement of 551 railways, representing a capital of over \$13,000,000,000, if not the most important, is certainly the most far-reaching agreement ever signed. The rules covered by this agreement provide for a uniform payment of 20 cents a day for each car. If any road holds a car more than 30 days, the owner upon due notice, can increase this rate to a dollar a day, thus putting into effect what is called the penalty rate. There are rules also which provide a certain relief for belt lines, rules providing for the necessary accounting features, for embargoes and for the arbitrating of differences.

Up to 1902 the arrangements for the settlement of freight car interchange in North America were in a very peculiar condition. When the first American railways were built it was not supposed that they would interchange their own cars. Indeed, it was generally thought that all cars would be provided by the shippers. The first cars interchanged between railways were generally not railway cars but cars belonging to "fast freight lines," some of which were owned

by individuals and others by associations of railways. It was quite general to divide the through rates charged by these fast freight lines on a mileage basis and it was natural that the expense for cars should be divided on the same basis. The first rate generally in effect was one cent per mile, and this rate, which was primarily applicable to private line cars only, was gradually extended to such railway cars as were interchanged, the car resources of the fast freight lines proving inadequate to supply cars for the traffic offering. The first of these railway cars interchanged appear to have been sent away from home without any definite understanding either as to compensation or as to reports of movements; but, as above, the rate of one cent per mile (which was afterward reduced to three fourth of a cent and later to six mills) came into general effect, and it was arranged by the Car Accountants' Association, which represented most of the railways of the country, that a "junction report" should be sent to the owner of each car whenever it was interchanged between foreign railroads. By entering up these junction reports in their car records each railway was able to locate its cars and to trace for them either by letter or by "Car Tracers" or "Lost Car Agents," who were largely employed to secure the return of cars. For, it should be noted that this mileage system, which had been adopted for the compensation of car owners, did nothing to secure the return of cars to their owners. Indeed, it was cheaper to hold a car indefinitely than to return it, as the actual movement of a car in the direction of home cost 75 or 60 cents for every hundred miles it moved, while it cost nothing to keep it standing. Another difficulty lay in the fact that there was no effective check on the accounts rendered by each railway for the use of the cars of others, and there was some suspicion that certain mileage accounts were cut. The vices of this system were early recognized by some of the railways and in the year 1876 the Union Pacific and the Chicago, Burlington & Quincy arranged to cover their own joint interchange by a per diem payment at the rate of 50 cents per car per day. This arrangement continued in effect for a couple of years with the result that the movement of the cars covered by this arrangement was greatly expedited. There was no general agreement, however, with other railways to put this arrangement into effect and it was, therefore, discontinued. The per diem system was later called to the attention of the Car Accountants' Association by J. T. Rigney, of the Baltimore & Ohio Railway, who in 1878 read a paper before that body urging its general adoption. Mr. Rigney's efforts were followed by W. P. Shinn, who covered the system in an admirable set of papers which did a great deal to mold the opinion of railroad men on the subject.

Although the condition became worse year after year and the delays to foreign equipment became very serious, especially at terminal points where individuals without capital were encouraged by the mileage system to undertake extensive business by using railway cars as warehouses, no steps were taken toward the mitigation of the mileage system until 1888 when it was brought before the Trunk Lines, and Albert Fink formulated a set of rules covering a mixed

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system, which provided for the payment of one half cent a mile and 15 cents a day for the use of cars. This plan was logical, inasmuch as the per diem rate was intended to cover the cost of depreciation and interest on investment, while the mileage rate was intended to cover repairs, but it was much more expensive in administration than the mileage rate. Unfortunately when it was adopted it was by two of the stronger lines without consultation with the rest of the country. As a result only a minority of the railways adhered to the plan and after it had been in effect for a month, there began a series of secessions of the railways which found it expensive in comparison with the mileage system. Each secession made the system more expensive to the two trunk lines which had originated the experiment and at the end of a few months the plan was definitely abandoned.

This experiment of 1888 was very expensive to some of the lines involved and the experience gained showed clearly that no experiment could succeed unless the arrangement was put into effect throughout substantially all the United States and Canada and was kept in effect until sufficient experience had been gained to warrant a change in the rules. The failure of the experiment also cast a shadow over "mixed car service systems," and subsequent movements have usually been in the direction of a straight per diem system. During the experiment of 1888 the detail of the rules was referred to the Committee on Car Service of the American Railway Association and this body has ever since had a general charge of the matter. It had early formulated a set of "Car Service Rules" which included the practice approved by the association in regard to the interchange of passenger and freight cars, but these rules although they covered fully the interchange of passenger cars and gave many particulars as to the proper handling of freight cars have always been silent as to the compensation for the use of freight cars interchanged. Rules covering per diem payments for use of freight cars were reported to the American Railway Association on several occasions by the Committee on Car Service between 1888 and 1901, but the rules were invariably referred back to the committee or tabled. Another mixed system, originated by J. M. Daly, was also tried on seven important western railways in 1898, but it lasted only a short time.

In the year 1901, however, the question was again taken up. For over a year through a remarkable revival of prosperity and expansion of industrial enterprise, there had been a marked shortage of cars on all the railways in the producing sections of the country, and these railways saw their own cars gradually leaving them only to be delayed without recourse upon foreign lines. It was by no means unusual for a railway to see half of its freight equipment and more on foreign lines, at a time when it could not fill its orders for cars. It is an open question whether the so-called "car shortage" was really a shortage of cars, a shortage of terminal facilities, a shortage of engines, a shortage of machine shops or a shortage of mechanics, but it was evident to every car owner that his cars were too long away from home, that he was not properly paid for their use, and that the foreign roads really had no incentive to return them. At

that time the rate paid per mile was six mills and the average earnings of cars on foreign lines was less than 12 cents a day. This was evidently the time for the introduction of the per diem system.

The loss to car owners in the poor movement of their cars was so evident that a group of prominent financiers commissioned J. W. Midgley to investigate and report upon the question. This gentleman's prior experience had been chiefly with the traffic and financial sides of railways, but in the investigation which he made of the subject he speedily recognized the advantages of a per diem system, which he pointed out in a series of forcible reports to the subscribers to his bureau, which were widely studied by the executive and operating officers of railways. These papers gave in great detail the history of the per diem movement and strongly urged the adoption of a per diem system, but, Mr. Midgley wisely confined his efforts to the awakening of interest in the matter and did not attempt to formulate a working plan. It was during this revival of interest in the subject that the American Railway Association met at Saint Louis in October 1901. The matter was carefully canvassed in the association and the last report of the Committee on Car Service was taken from the table and referred back with instructions to prepare a practical scheme for the introduction of the per diem system. This action was taken without opposition, as the railways which were profiting by the mileage system did not apparently realize the decided feeling on the subject and the far-reaching character of the instructions given the committee. For the next six months the Committee on Car Service was busily occupied in formulating a set of rules for the per diem system, in which they were aided by a large majority of the roads in the country. The circulars of the committee, asking for information, were answered fully and carefully and the committee in its deliberations was, therefore, guided by the views of practically all the men in the country who had experience in car service matters. At the same time the opposition began to crystallize. A per diem plan, such as had been heretofore presented, was most objectionable, first, to the belt railways, which had never paid any mileage at all; second, to all the short railways, which made a small mileage per day on foreign cars; and third, to certain private owners of cars, and especially of refrigerator and stock cars, which, for traffic reasons, were moved on fast freight trains and which made high mileage per day. Many of these private parties were also interested in railroads and it was felt their opposition might seriously complicate the adoption of the per diem system.

The first duty of the committee, was, of course, to construct a workable system, and in this they were aided greatly by the experience gained in 1888. The car accounting features of the rules as decided upon, presented, therefore, no marked innovation and have worked without friction. Prior schemes had not, however, provided for the settlement of differences of opinion in regard to the rule or any continuity of the arrangement. These points were covered by arranging for an arbitration committee and also for a per diem agreement to be signed by the railways participating. Having arranged a

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scheme which would be workable generally, it was necessary for the committee to provide for certain exceptional cases. This it did by arranging that the per diem should be regularly reported at the end of every month and exceptions should be covered later by a system of what they term "reclaims," the word reclaim being adopted instead of refund, or some more usual term, in order to separate the reclaim payments from all others. It was felt that the circumstances in different parts of the country so varied that no central body could settle exactly what would be a fair reclaim for cars in switching service on belt roads, but it was decided that any reclaim that was made should be an arbitrary amount per car, so as to preserve the incentive for prompt movement. It was also provided that the per diem on cars refused at interchange points should be covered by reclaim and provision was made for special reclaim covering special circumstances.

It then remained for the committee to figure out a per diem rate which could be accepted in all parts of the country and here they were urged on one side to make the rate as low as 12½ cents a day and on the other, to make it as high as one cent per ton capacity. A compromise rate was the only one that could be generally accepted, and the committee finally advised a 20 cent rate, with the proviso that in case a car was delayed on any one line longer than 30 days, a penalty rate of \$1 could be imposed in lieu of the per diem rate. The opposition of private car owners was obviated by leaving private cars entirely out of the question and providing that per diem rules covered railway cars only.

With this scheme worked out the committee reported to the American Railway Association at its meeting in New York in April 1902, where the rules were debated in full and the liveliest opposition encountered on the part of advocates of mileage, of low rates, and of high rates. The rules, however, were adopted by the association by a large majority and it was agreed to put the plan into effect on 1 July 1902, provided that the agreement was signed by a majority of the whole membership of the association and provided that that majority owned 66 per cent of the cars owned by all the members of the association. The agreement was promptly circulated among the railways of the country at large and the secretary of the association was able to announce in a comparatively short time that the agreement had been signed by the desired number of members. There was some opposition on the part of a comparatively small number of roads in the East who attempted to make an exception of cars loaded with cotton, but this was promptly settled by the withdrawal by the per diem railways of all through rates on cotton to the territory in question, a stroke which led to an immediate adhesion to the per diem plan of practically all dissenters.

This plan has now been in effect for about two years and while there are still certain difficulties in its administration there seems to be no prospect of a departure from the general per diem principle. Indeed, there is a strong movement in the direction of applying the principle to private cars. It was anticipated when these rules went into effect that there would be con-

stant litigation under them, but the fact that there have been only 16 cases decided by the Arbitration Committee shows that the rules are generally satisfactory. To be sure, a number of the larger car owners are still pressing for a higher rate and an abolition of the penalty which will possibly be arranged in time, and a number of industrial railways are endeavoring to enter the scheme because of the very liberal reclaim allowed on switched cars. Again, there is a disposition shown on the part of some of the larger systems to divide themselves for car accounting purposes in order to avoid the penalty rate, but none of the difficulties involved appear to be radical or to approach in magnitude the radical difficulties of the past mileage systems. It is thought, therefore, by a careful revision of the rules from time to time the per diem system can be maintained and its efficiency improved.

ARTHUR HALE,
Gen. Supt. Transportation Baltimore & Ohio Railroad Co.

Railway, Intercontinental, or Pan-American, a proposed railway system extending from the United States through Mexico and the Central American states to Panama, and thence southward to Brazil. The Intercontinental Railroad Commission was organized in Washington in 1889 to study the feasibility of extending a trunk railway from our country to Buenos Ayres. The report of the commission on its studies and its surveys for the best route was published in 1899. The proposed all-rail route to Buenos Ayres will be 10,228 miles long by the route which the surveyors selected. In 1900 the existing lines that might be used as a part of the trunk railway were about 4,772 miles in length, leaving 5,456 miles to be constructed. Since that time the Latin-American countries have built 656 miles of track along the international route, reducing the portion yet to be constructed to 4,800 miles. Only about an eighth of the mileage has been built since 1900, but this has been done in the natural course of railway building without any reference to the Intercontinental project. The estimated cost of construction for the 4,800 miles is placed at \$150,000,000. This is based on an average of 50 cents gold as the daily wage labor, with an efficiency of 75 per cent as compared with similar labor in the United States.

Railway Labor Organizations, labor unions formed by the employees of railways to advance their interests and promote their social, moral, and intellectual welfare. The larger and more typical railway labor organizations are distinguished for their generally conservative attitude, their large mutual benefit and insurance funds, and their organization of grievance committees for arranging differences between their members and employers, and avoiding strikes. As a rule they maintain pleasant relations with employers, and have been instrumental in obtaining increased wages and general improvement in the condition of railway labor. The five most prominent organizations are the Grand International Brotherhood of Locomotive Engineers, the Order of Railroad Conductors, the Brotherhood of Locomotive Firemen, the Brotherhood of Railway Trainmen, and the Order of Railroad Telegraphers. These five have the same general form of organization, with

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the supreme power in the central representative body called the Grand Lodge or Grand Division, meeting in convention every two years, and the executive power vested in a chief executive (Grand Master or Grand President) and an executive board. Their subordinate divisions include locals and section divisions, the latter made up of the employees of one railway line or system. Their provisions for dealing with grievances against employers are as follows: Any member or members having a grievance against an employer are to report the same to their local organization, which, in case the majority vote to sustain the grievance, shall refer it to a local grievance committee. This committee is to deal with the local management, and should no satisfactory settlement be made, refer the grievance to the General Grievance Committee of the section, who shall confer with the general manager of the railway system. Then, if no adjustment be made, the matter is to be referred to the chief executive of the union who shall make another attempt to adjust the matter with the employers, and, if he fail, he and the General Committee shall have power to sanction a strike, provided a strike is agreed upon by two thirds of the members involved. In some cases a board of adjustment is formed by the chairmen of three or more general committees, in which case the matter is to be referred to this board before going to the chief executive. It will be seen that this arrangement makes a strike difficult to bring about, and prevents strikes for trivial causes, yet all of these unions have established large protective or strike funds for the benefit of members when on strike. Another feature of these organizations is the Legislative Board, organized in each State by representatives from each local for the consideration of questions of legislation affecting their unions; and these boards have power to appoint one or two members to remain at the State capital for securing desired legislation.

The Five Larger Brotherhoods.—(1) The Brotherhood of Locomotive Engineers was organized in 1863. The locals have sick and death benefit funds, and the Brotherhood has a fund for pensioning widows and children of the deceased. The insurance is under the management of an affiliated organization known as the Locomotive Engineers Mutual Life and Accident Insurance Association. In 1903 the brotherhood numbered 42,000 members in 596 locals. The official journal is the 'Journal of the Brotherhood of Locomotive Engineers,' published monthly. It ranks among the most important and influential labor organizations of the United States and is noted for its conservatism. (2) The Order of Railway Conductors was organized in 1868 as the Conductors' Brotherhood, was threatened with serious difficulty on account of its prohibition of strikes, and a rival union started which had a "protective" policy, the Order adopted the same policy, established its "protective" fund, and the two organizations were united under the present name. It has a mutual benefit fund, and the strike fund provides for the payment of \$50 per month to strikers for not over three months. The official journal is the 'Railway Conductor,' published monthly. In 1904 the membership was 32,000 in 454 locals. (3) The Brotherhood of

Locomotive Firemen was organized in 1873, was involved in the great strike of 1877 and seriously crippled; for a time it adopted the policy of "ignoring" strikes, but in 1885 returned to its original policy and methods in dealing with strikes; and a few years later conducted a large strike on the Chicago, Burlington & Quincy Railroad. Strikers are paid \$25 per month for three months or less. The official journal is the 'Locomotive Firemen's Magazine.' The membership in 1904 was 51,356 in 656 locals. (4) The Brotherhood of Railroad Trainmen was organized in September 1883, and admits to membership conductors, baggagemen, yardmasters, and switchmen beside trainmen. They have a sick and death benefit fund, and a strike fund, providing for a payment of \$35 per month to strikers for three months or less. In 1904 it had 68,158 members in 699 locals; its official organ is the 'Railroad Trainmen's Journal.' (5) The Order of Railroad Telegraphers was organized in 1886; its membership includes telegraphers, line repairers, levermen, and interlockers. Its mutual benefit fund was established in 1898; it has never held quite the same position of importance as the other four brotherhoods, as at the first it grew more slowly because the telegraphers are scattered, and it is difficult to get any number together, but since 1900 has grown rapidly. In 1903 it numbered 30,000; its official journal is the 'Railroad Telegrapher.'

The Union of All Railway Employees.—Though these brotherhoods have much in common in organization and purpose there has been rivalry and discord among them, which has proved decidedly detrimental to their best interests. In 1895 an alliance between the five brotherhoods was formed, providing for the formation of a Federated Board of Adjustment for the consideration of grievances and management of strikes. A more centralized Federation was organized in 1898, but dissolved in 1900, leaving the agreement of 1895 in force. The first attempt to form a union which should unite in one organization all classes of railway employees was the American Railway Union, organized in the early part of 1893 by Eugene Victor Debs. This union lacked the complicated organization of the older brotherhoods, was radical and aggressive, and met with bitter opposition from the older unions. It drew away some of their membership and grew rapidly; before the close of the year it conducted successfully a strike against the Great Northern Railroad. In 1894 it inaugurated a sympathetic strike in behalf of the Pullman Car Company employees, was defeated, and shortly afterward the organization dissolved. A later attempt to unite all railway employees is the United Brotherhood of Railway Employees, organized in January 1901. It resembles the older brotherhoods in its organization and its mutual benefit department, but differs from them in its opposition to separate trade organization, and in its radical policy, being affiliated with the American Labor Union, which is avowedly socialistic. The chief strength of this Brotherhood is in the Western States.

Lesser Organizations.—Of the smaller organizations those which closely resemble the five larger brotherhoods in organization are: (1) The International Brotherhood of Main-

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tenance-of-Way Employees, organized in 1887 as the Brotherhood of Railway Trackmen; its membership includes those employed in track, bridge, and building, water supply and fuel departments, and signal and interlocking service; it has a mutual benefit department, and the same provisions for preventing strikes and dealing with grievances as the other brotherhoods; the official journal is the 'Advance Advocate'; the membership in 1903 was over 10,000. (2) The Switchmen's Union of North America, organized in 1894, admits to membership those engaged in making up and disposing of trains. It has a beneficiary department, membership in which is compulsory for those physically sound. The organization is the same as in the other brotherhoods. The membership in 1904 was 23,000; this is less than it would otherwise be because of the fact that the Brotherhood of Railroad Trainmen, an older and more powerful organization, also admits switchmen. The official organ is the 'Journal of the Switchmen's Union.' (3) The Brotherhood of Railway Car-men, organized in 1900 by a consolidation of the Brotherhood Car Repairers of North America and the Car-men's Mutual Aid Association. Its membership consists of those who are employed in oiling, repairing, inspecting, and cleaning cars; it is a comparatively unimportant organization. (4) The National Railways Clerks' Association, organized in 1901, had in 1903 a membership of 4,000 in 35 locals; it publishes the 'Official Journal of the N. R. C. A.' (5) The International Association of Car Workers, organized in 1901, includes in its membership those employed in the construction and maintenance of all cars; it has no benefit department, but the arrangement for dealing with grievances and strikes by local and general grievance committees; its declaration of principles is conservative, including opposition to prison contract labor, and a declaration in favor of reduction of hours of work, and compulsory education. Its official journal is the 'Car Worker'; its membership in 1903 was 20,000. Of these organizations the Brotherhood of Maintenance-of-Way Employees and the International Association of Car Workers are affiliated with the American Federation of Labor (in 1904).

There is also affiliated with the Federation another railway clerks' organization known as the International Association of Railway Clerks, organized in April 1903. Its organization differs from that of the railway brotherhoods; it has annual instead of biennial conventions, no benefit department, and no system of grievance committees; a strike, however, must be approved by the district council or international executive board.

Railway Locomotive Repairs. The average life of a locomotive between the times of receiving general repairs to flues and machinery depends chiefly on the condition of the track over which the engine works, the number of tons of freight which the engine is required to haul, and the kind of water used in the boiler. If the road pass through mountainous regions and the track has many curves, the wear on the tires and machinery is exceedingly rapid and the life of the engine will be but a few months; or if the road pass through hard water districts where the water contains much solid matter,

such as lime and other ingredients, the incrustation of these substances on the flues will soon render the engine unfit for further service on account of leaky flues and failures for steam. The length of time an engine may be kept in service will also depend on the roundhouse inspection and care given at the terminals of the divisions. Observance and attention to little things will often save a failure, maybe a wreck, on the road. The tightening of nuts and the application of cotters may save the bolt, which, if allowed to drop out, would result in serious damage to the engine. In bad water districts the boiler should be washed frequently and thoroughly so as to remove all accumulations of sediment. Careful attention to this work will add much to the life of the flues and the steaming qualities of the engine.

The following card, if properly used, will be found very effective in securing a thorough inspection at the end of each trip. The engine inspector should place a check mark on the square opposite the number of each item as he inspects that part and when the inspection has been completed any defects found should be noted on the back of the card. A work report

A. B. C. RAILROAD COMPANY

ENGINE INSPECTOR'S REPORT.

Engine No. _____

		Division	190
1	Axles	38	Grab handles
2	Ash pans	39	Gauge light
3	Automatic coupler	40	Headlight
4	Air governor	41	Hand rails
5	Air pump	42	Hose
6	Air pipes	43	Injector
7	Air reservoir	44	Injector pipe
8	Air brakes	45	Injector check
9	Air signal	46	Links
10	Boiler	47	Pedestal braces
11	Bell	48	Pedestal bolts
12	Cylinders	49	Piston rod packing
13	Cylinder cocks	50	Quadrant
14	Cross heads	51	Rods
15	Cab	52	Reach rod
16	Cab fastenings	53	Reverse lever
17	Cistern	54	Rocker arms
18	Driving wheels	55	Rocker boxes
19	Driving axles	56	Running boards
20	Driving boxes	57	Signal light
21	Driver springs	58	Smoke box
22	Draw bar	59	Safety chain
23	Draw bar pins	60	Steps
24	Engine trucks	61	Steam heat
25	Eccentrics	62	Sanding apparatus
26	Eccentric straps	63	Strainers
27	Eccentric rods	64	Stack
28	Expansion braces	65	Shoes and wedges
29	Frames	66	Tank valve
30	Frame bolts	67	Tumbling shaft
31	Frame keys	68	Tender trucks
32	Fire-box	69	Tender wheels
33	Fire doors	70	Valve stem packing
34	Flues	71	Water glass
35	Grate rigging	72	Water glass cock
36	Gauges	73	Whistle
37	Guides	74	Wheels

should also be made out covering the defects found and turned over to the proper person to make the repairs. Before the engine leaves the terminal the inspector should again look the engine over to see that all repairs have been made. The work report and card can then be turned over to the proper authority as a matter of permanent record.

Light repairs, such as examining pistons, renewing cylinder packing rings, closing rod braces, replacing bolts, and similar work, are usually classed under what is termed running or

RAILWAY LOCOMOTIVE REPAIRS

roundhouse repairs and are accomplished at the end of the trip before the engine is turned for further service.

When the engine has become so badly worn that a general over-hauling and renewal of parts are necessary it is then sent to the back shop for either general or certain specified repairs.

On roads having a large number of engines of different types, and a number of small shops, general or even light repairs cannot be accomplished to the best advantage unless the engines are regularly assigned to certain divisions. Where locomotives are regularly assigned to certain parts of the road, the master mechanic in charge of repairs can so arrange his stock of material as to immediately meet the requirements of the engines on his division and general repairs can be made in the shortest possible time. But where the shop manager has no means of knowing what classes of engines will be sent to his shop for repairs until he has actually received the engine, it is impossible to carry in stock the necessary parts to make quick repairs.

A report may be made by the master mechanic to the shop superintendent prior to the time of forwarding the engine, setting forth in detail what repairs will be necessary, but it will usually be found that something has been omitted and more or less delay will result. Any delay of this kind will entail a loss to the company dependent on the volume of business and variously estimated at from 10 to 25 dollars for each 24 hours the engine is out of service. Locomotive repairs are usually divided into five classes, as follows:

Class 1 repairs—	\$2,500.00 and over.
Class 2 repairs—	1,500.00 to \$2,500.00
Class 3 repairs—	500.00 to 1,500.00
Class 4 repairs—	100.00 to 500.00
Class 5 repairs—	10.00 to 100.00

The Erecting Shop.—Work in this department should be classified and a certain part of the repairs on all engines in shop assigned to individual gang foremen. It was formerly the custom to assign each gang foreman to a certain number of pits in which case all necessary erecting shop repairs to an engine was completed by a few men. This practice is still followed in some shops to the detriment of economic operation. When workmen are regularly assigned to certain classes of repairs they become specialists and are able to accomplish the work quicker and easier than it is possible without classifications. This distribution of the erecting work should be arranged about as follows:

Gang No. 1. Stripping work, such as rods, motion work, guides, pistons, steam chests, brake rigging, injectors, pipes, pilots, cabs, frames, cylinders, trucks, etc.

Gang No. 2. Replacing frames and cylinders, chipping and filing frame jaws, fitting pedestal shoes and wedges, removing wheels and wheeling engines, overhauling and applying spring and brake rigging, trucks, etc.

Gang No. 3. Replacing all boiler mounting, overhauling pops and whistles, removing, overhauling, and replacing steam and dry pipes, laying out all new boilers for location of gauge cocks, drilling, lapping, and applying all studs in boiler, applying injectors, lubricators, etc.

Gang No. 4. Putting up all motion work, such as links and hangers, eccentrics, eccentric straps and rods, rocker boxes, reach rods, re-

verse lever, lift shaft, setting valves, lining guides, putting up valves, steam chests, pistons, etc.

Gang No. 5. Overhauling air pumps, injectors, lubricators, gauge cocks, and gauges, and all air brake attachments, and testing brakes when applied.

The Fitting Department.—This work should be under the supervision of the machine shop foreman, and should include refitting all rods, links, rocker boxes, reverse levers, pistons, crossheads, valves, and similar work. This is necessary on account of the large number of machine operations on this class of work. If the vises and machinery necessary to carry on this work are located in close range, it will enable the mechanics to work together to better advantage, and require less supervision to produce necessary results. It will also avoid trucking the parts from vise to machine and back again, and from one machine to another in different parts of the shop.

Inspection.—When an engine is sent to the back shop for general repairs it should be carefully inspected by a competent man and a condition report made to the shop superintendent. The principal features of this report should then be made out in duplicate and a copy furnished to each foreman and gang foreman in the shop so that all will be well posted as to the work required.

The Shop Foremen's Meeting.—On Friday afternoon of each week a schedule should be made out showing the number of engines to be completed the following week, and the foremen and gang foremen should be called together in a short meeting. The shop superintendent may require statements of the condition of the various departments and each locomotive on the schedule for the following week should be discussed in detail and any expected delays brought to light and accounted for. A half hour spent each week in discussing the general progress of the work in the different departments in a meeting of this kind will, in a short time, produce very gratifying results. Shop improvements, the location of tools to reduce cost of handling material, air jacks, changes in patterns to reduce the amount of machine work, or to increase the strength or wearing of parts, and many other details of the work can be talked over in these shop meetings and if suggestions are carefully carried out, it will soon result in a largely increased output of the plant.

When an engine has been carefully inspected and the foreman of the stripping gang has received a copy of the inspection referred to above, it is set in the shop over the drop pit and is ready to be stripped down.

Some shops are equipped with a drop table. The engine is run onto this table, blocked at each end and all wheels dropped at same time. In other shops a drop pit is constructed with a hydraulic hoist in the centre capable of dropping one pair of wheels at a time. In still other shops no drop pit is supplied and it is necessary to jack the engine high enough to run the wheels out. In shops of this kind, when the supply of air is sufficient, pneumatic telescope jacks should be supplied for removing wheels. The jacks can be mounted on a small pair of truck wheels and by placing two of them alternately under each end of the engine the wheels can be removed in one-half to three-quarters of an hour.

RAILWAY LOCOMOTIVE REPAIRS

In shops equipped with sufficient crane facilities, the motion work may be cut loose and the engine lifted to a permanent position before further stripping is done. No matter what method may be used to remove the wheels, the rods and attachments should be removed before the engine is put in the shop, loaded on a dummy car, cleaned, and delivered as a whole to the vise men to be refitted. If this can be done conveniently it will avoid much delay and confusion as other parts are being stripped. When the remaining parts of the engine have been stripped, they should at once be properly stencilled, cleaned, and delivered to the different departments for repairs. The card shown in the following illustration will be found very convenient in handling the work between different departments of the shop.

A. B. C. RAILROAD COMPANY

WORK REPORT

Engine No. _____ In shop _____ 190____. To be out
190____. Mr. _____ Foreman
_____ shop. Make following repairs.

When completed return card to _____

NAME OF PART	DESCRIPTION OF WORK REQUIRED

Above parts delivered to _____ shop
_____ 190____. Work completed and card
delivered to _____ 190____.

NOTE:—Work on this card must be completed and ready for
delivery to _____ shop
_____ days before engine is marked for service.

This card may be used in any one of the following ways:

1. The general foreman may require each gang foreman or general work inspector to carefully inspect all parts after engine is stripped and furnish to the clerical force in his office all necessary information concerning the requirements of the engine. The cards can then be properly filled out and sent to the respective departments in which the repairs are to be made.
2. The engine being inspected and stripped in the erecting shop, the foreman of this department may require the gang foreman in charge of each class of repairs to carefully inspect his part of the work as soon as it has been removed, and report to his office the work necessary to be done, and the clerk can then make out the card and forward to the respective heads of departments.
3. The gang foreman in charge of the different classes of work may be authorized to make out cards covering the work necessary on their part of the engine and forward to the heads of other departments at the time worn or broken parts are delivered for repairs or renewal. When the parts have been fitted and are ready to apply to engine, the cards may be

returned to the gang foreman who first made them out. This will, without further notice, place him in a position to put up the work in the shortest time possible.

These cards may also be used by the machine shop foreman for work required in the blacksmith shop or by any department requiring work from some other department.

Another small card which will be found very convenient for use among different departments is shown below. This card can be used in ordering bolts, and all miscellaneous work which will necessarily be omitted from the general order for repairs, referred to above.

A. B. C. RAILROAD COMPANY

FOREMAN'S CROSS ORDER

Please furnish and charge _____

190____.

Foreman.

Shoes and Wedges.— This is one of the most important jobs on an engine, and must receive the most careful attention as it will prevent cutting tires, breaking crank pins, and avoid much trouble with hot driving boxes and cut journals.

In filing the frame jaws much care should be exercised to see that they are made perfectly true up and down and kept square with the outside of the frame. A scraper should be used to insure a good bearing and shoes and wedges should then be carefully fitted to the jaws.

In fitting the pedestal braces the workman should be careful to see that there is no unnatural strain on the jaws of the frame, and if the braces are new they must be clamped firmly against the frame in the position which they will occupy when work is finished, and scribed for slotting. Old braces should be tried in position on the frame and if loose sent to the blacksmith shop to be closed and then refitted to frame. Thimble braces, or braces which fit between the jaws of the frame, may be lined on end if loose and refitted to jaws.

Cylinders.— In fitting new cylinders to shell of smoke box, the cylinders should be placed in proper working position and the arch allowed to rest on the saddle. Level the boiler with the cylinders. Line both cylinders and divide firebox central with lines. Drop plumb line over top of boiler and keep firebox plumb with both lines.

If the saddle will finish so as to hold the boiler the proper height, it may be laid off in this position and circle chipped to fit smoke box. If the circle of the saddle is too large for the boiler and will not true up, a piece of sheet iron or boiler plate can be used and the thickness of the same figured in laying off.

Boring Old Cylinders.— In placing the boring bar in old cylinders, be careful to set it with the counterbore of the cylinder at each end, or if back head is in place, a taper gland may be used in the stuffing box. If cylinder is badly worn, two roughing cuts will be required, and if the bar has the necessary power, the speed should be 30 to 40 feet per minute with a feed of at least $\frac{1}{8}$ inch. The finish cut can be taken with a

RAILWAY LOCOMOTIVE REPAIRS

wide nose tool at same speed but with a feed varying from $\frac{1}{2}$ to 1 inch per revolution of bar. If required, each end of cylinder should be re-counterbored with offset tool. Sometimes the tool will chatter, and this may be largely relieved by hanging a heavy weight on the back end of the bar.

Cylinders are counterbored to prevent piston from wearing a shoulder at each end, and this counterbore should extend back far enough so that the outside packing ring will just pass over the inner edge.

Rods.—The length of main rods can be obtained by placing crosshead in exact centre of guides and using a square from centre of main driving box. One end of a stick can be placed against the crosshead pin and a line scribed on back end of stick to coincide with centre of main box. Then all one-half the diameter of the crosshead pin and the result will be the proper length of the rod. In adjusting main rods to proper length, the position of the key with reference to the pin should be noted. When the key is in front of the pin, the rod is lengthened as the brass wears, and when behind the pin the rod is made shorter as the pin is driven down. The clearance, therefore, should be divided accordingly.

The length of parallel rods may be obtained by measuring from wheel centres when the wheels are under the engine. When the wheels are not under the engine, the distance between the centre of frame jaws can be measured. In either case, if the engine is cold, 1-32 inch should be allowed in length of back rod for expansion on all engines where the fire box sets down between the two back pair of wheels.

In hanging the rods, fill the wheel centres with lead, mark the exact centre of each wheel, and use tram. If the wheels are out of tram, then try the main wheel centres with centre in rocker arms, which are supposed to be right in all cases, and set shoes and wedges where needed so as to bring wheels to tram and also to keep them square with rocker boxes. When the main wheels are arranged in proper position, the others can be changed accordingly. Shoes and wedges should be set moderately tight before tramping main centres.

When pins all tram, pinch one side of engine on dead centre and put up rods on that side. Then pinch the other side the same way and hang rods. The rods should be closely lined between the pins.

In fitting the brasses to the top straps, file out top and bottom to give a good side bearing. Key the brasses up and try on pin, taking out all lost motion to prevent pounding. Rod brasses should always have a good bearing on the pin and should have a Russia iron liner between the halves before boring. They should be tightly keyed up and bored 1-32 inch larger than the pin. After they are bored, the liner should be removing before applying to pin.

Guides.—In lining four bar guides it is best to first put a centre in the crosshead and set guide gauge to it from bottom of head. The bottom guides should then be put up and cylinders lined. Always use a small line and be exact in measurements.

The guides must be kept perfectly true and level with frames across face. The crosshead should be calipered to get width between guides

and about 1-32 inch allowed for lateral motion or side play.

The guides must be divided central and kept perfectly parallel with line. A straight edge can be tried on the face of the guides and if they are out in the centre they may be sprung into place with liners.

When the bottom guides are properly set, the crosshead should be put in place and tried in all positions to see that it is true at all points. The top guide can now be put into place and lined down so as to allow the crosshead to work freely.

In lining two bar guides, run a small line through the cylinder. Measure the distance from bottom face of crosshead gib to centre. The bottom guide should be set this distance from line. The crosshead can be calipered and top guides set the required distance from bottom guide.

A gauge must be used on both sides and guides kept central with line and square with top of frame. The crosshead should be put in place and as many liners as possible used under top guide, so that they can be closed as the crosshead wears.

Valves and Steam Chests.—In truing up old valve seats, it is best to use a valve seat-facing machine where one is obtainable. If a machine is not in use it is necessary to chip with chisel and hammer if the seat is bad, then use a bastard file to produce a fine bearing with the face plate or calve. A smooth file or scraper can then be used to bring the surface down to a good bearing. The valve seat must be kept the same height at all points.

To line down the pressure or valve balance plate, get the exact height from the seat for the gasket to the top of the valve, and the thickness of the chest outside of the gaskets. Then allow for the thickness of the gaskets and about 1-32 inch to draw down and the plate to these measurements.

In putting up steam chests and covers in erecting shop, care should be taken to see that the gaskets are well fitted to the grooves in the cylinder. The nuts on the cover must be drawn down very tightly to prevent the steam chest leaking around the joints.

Steam and Dry Pipes.—This is one of the most important parts of the engine and requires some skill in making proper joints between the pipes so that all leaks will be avoided. The joints must be perfect in every respect with as wide face for the flat bearings as possible. If this work is not carefully done, when the engine has made one or two trips in heavy service, more or less of it will have to be gone over again.

In grinding joints, No. 1 emery may be used for all brass to brass joints, and No. 2 emery for all iron to iron joints. The joints should be ground until there is about $\frac{1}{4}$ inch bearing in the worst place.

If joints are badly worn, face them off in machine or scrape before grinding. A tool similar to a carpenter's brace may then be used in grinding.

Use block and tackle where necessary in applying pipes. When dry pipe is put in place, see that a perfect joint is made between ring on pipe and flue sheet. Fasten pipe securely to dry pipe with key bolts and strap, or flange with bolts and nuts. Be sure to keep top level. Fasten to dome and put in throttle box and

RAILWAY MILEAGE AND COST OF CONSTRUCTION

throttle. Connect up throttle rigging carefully and securely so that no trouble can occur in the future.

Blacksmith Shop.—In this department it is usually necessary to do more or less car work, track and bridge work in connection with the regular locomotive repairs. To do this successfully, the foreman should carefully classify the work, giving to the furnaces such parts as can be most successfully done in this way, and distributing among the forges the remainder of the work in such a way as to give to each fire a regular class of repairs.

The bolt heading machinery, shears, and furnaces necessary to heat all bolts should be located in close proximity so that when iron is delivered to the shears it can be cut off, the bolts passed to the furnaces, headed and delivered to storage bins with the least possible handling. Such an arrangement as this in any large shop where thousands of bolts are made each month will save much time and money.

Particular attention must be given to the furnace, which should be oil and not coal, to see that it is capable of heating the iron as fast as

2. Flanging flue sheets and door sheets, rolling side and crown sheets and bolting fireboxes together ready to rivet.

3. Riveting, chipping and caulking firebox, putting in place, setting mud ring and riveting complete.

4. Putting on crown bars, driving stay bolts, renewing side sheets, front and back flue sheets, flanging and putting on back door sheet and throat sheet, cutting out, rolling, and applying smoke box.

5. Cutting out all rivets, breaking out stay-bolts, and removing mud rings, fireboxes, and other parts.

6. Tapping stay bolt holes, screwing in stay bolts, setting to place, and cutting ready to drive.

7. Cutting out flues, removing from boiler and putting in rattler.

8. Setting flues in boiler complete.

9. Flue plant.

Drive rivets with pneumatic hammer wherever possible. Break out stay bolts with pneumatic ram. Chip and caulk by air and not by hand. Use air motor to tap stay bolt holes and

DRAW BAR SPRING FOLLOWER PLATES

System.

1. Bar iron brought into shop, cut to length, and put into oil furnace.
2. Remove when hot, 2" hole punched through to within 1/4", leaving dowel on opposite side of plate, and plates loaded on iron truck.
3. Deliver to store shed.

Absence of System.

1. Bar iron delivered to shears.
2. Plates cut to length, heat in coal furnace, and 1/8" hole punched.
3. Deliver to smith at forge.
4. Round bar iron 1-1/8" diameter delivered to shears.
5. Cut to 6" lengths.
6. Deliver to upsetting machine.
7. Dowels upset to 2" and cut off.
8. Dowels delivered to blacksmith.
9. Heat in open fire, put in plate and rivet on anvil with sledge.
10. Deliver to store shed.

BRAKE LEVERS

System.

1. Bar iron brought in, levers cut off and put in oil furnace.
2. Heat, draw out under hammer, cut to length, and load on iron truck.
3. Deliver to drill press.

Absence of System.

1. Bar iron delivered to shears.
2. Cut off.
3. Put into coal furnace.
4. Heat and draw out under power hammer.
5. Deliver back to shears.
6. Cut to length.
7. Load on trucks and deliver to drill.

the machine will head the bolts. Oil furnaces and bulldozers or air bending machines should be provided for car work, such as arch bars, brake hangers, brake rods, etc. For making brake staffs, eccentric jaw pins, and all similar work which can be handled in dies, a Bradley cushion hammer or one of similar make should be used. These hammers are not expensive in first cost, but their use will have a very gratifying effect in reducing the cost of repairs.

The above illustration gives some idea of what may be accomplished by a systematic classification of blacksmith work.

Boiler Shop.—Greater gains can be made in this department than in any other, perhaps, by a systematic classification of the work. If no particular attention is given to assigning certain men to certain classes of work, it will soon be found that the output of the plant is being limited on account of slow returns from the boiler shop. The repairs in this department, no matter whether the shop be large or small, may be organized and men regularly assigned to certain operations in the following manner:

1. Ash pans, new and repairs, includes putting upon engine.

screw in stay bolts. Use a small automatic gang drill to drill detective holes in stay bolts. Don't heat them and punch. It destroys the even quality of the iron. Cut out, expand, and roll flues by air. Cut off safe ends with bevel rotary cutter. This cuts and scarfs the piece all in one operation.

W. S. COZAD,

Shop Specialist, Erie Railroad Co.

Railway Mileage and Cost of Construction. The following table, which has been compiled both from the special report of the Bureau of Statistics of the United States Department of Labor and from other authorities, attempts to present a picture of the condition of railroad transportation shortly after the beginning of the 20th century. While it has been possible to obtain a reasonably accurate estimate of the number of miles of railway in each country, the lack of census figures in several cases has prevented the completion of the column relating to population, while the absence of any authentic information concerning the financial standing of the roads has necessitated the omission of the

RAILWAY PASSENGER STATIONS OF THE WORLD

cost of construction, or capital cost, in many countries. The statement follows:

Country.	Year.	Mileage.		Cost of Construction.	
		Total.	Per 10,000 pop.	Total capital or cost.	Capital or cost per mile.
Europe:					
Germany	1904	33,819	5.8	\$3,245,368	*98,443
Austria-Hungary.....	1903	23,609	4.7	8,440,650	†
United Kingdom.....	1904	22,634	5.4	6,173,126	272,737
France.....	1904	28,102	7.2	3,295,811	*137,601
Russia and Finland.....	1902	35,323	2.9	2,828,753	†
Italy.....	1904	9,966	3.1	1,077,902	108,212
Belgium.....	1904	4,237	6.3	405,130	*160,893
Netherlands and Luxembourg.....	1904	2,005	3.7	32,836	\$41,086
Switzerland.....	1904	2,576	7.7	261,059	*104,969
Spain.....	1904	8,607	4.6	.....	.....
Portugal.....	1904	1,488	2.7	.....	.....
Denmark.....	1904	1,993	8.0	52,836	*41,086
Norway.....	1904	1,456	6.4	54,600	32,198
Sweden.....	1904	7,607	14.8	126,719	\$44,660
Serbia.....	1904	359	1.4	23,324	69,416
Romania.....	1903	1,974	3.3	172,457	87,364
Greece.....	1904	643	2.6	.....	.....
Turkey and Bulgaria.....	1904	1,953	2.0	.....	.....
America:					
United States.....	1905	111,074	25.9	11,664,191	55,261
Canada.....	1904	19,611	35.0	1,186,547	60,504
Newfoundland.....	1904	656	30.2	.....	.....
Mexico.....	1904	10,356	7.6	.....	.....
Central America.....	1904	946	2.2	.....	.....
Cuba.....	1904	1,583	10.1	.....	.....
Jamaica.....	1904	185	2.4	.....	.....
Porto Rico.....	1904	137	1.4	.....	.....
Colombia.....	1904	400	1.0	.....	.....
Venezuela.....	1904	631	2.6	37,828	70,972
Ecuador.....	1904	186	1.5	.....	.....
Peru.....	1904	1,036	2.2	.....	.....
Bolivia.....	1904	656	3.6	.....	.....
Brazil.....	1904	9,368	6.5	.....	.....
Paraguay.....	1904	157	8.1	.....	.....
Uruguay.....	1904	1,210	12.6	52,598	*152,756
Chile.....	1904	2,884	9.5	75,208	*154,697
Argentina.....	1903	11,559	22.5	576,734	49,895
Asia:					
British India.....	1904	27,565	1.0	1,144,704	41,531
Ceylon.....	1904	391	1.0	.....	.....
Asia Minor.....	1904	2,000	1.0	.....	.....
Russian Central Asia.....	1904	1,658	2.1	.....	.....
Siberia and Manchuria.....	1904	5,664	9.8	.....	.....
Persia.....	1904	34	0.04	.....	.....
Dutch East Indies.....	1903	1,456	0.5	77,232	53,044
Japan.....	1904	4,405	1.0	182,257	40,547
China.....	1904	1,176	0.03	.....	.....
Korea.....	1904	37	0.01	.....	.....
Siam.....	1904	140	0.4	4,998	23,305
Africa:					
Egypt.....	1904	2,953	3.0	.....	.....
Algeria and Tunis.....	1904	3,041	4.5	131,781	*58,053
Congo State.....	1904	876	.....	.....	.....
Abyssinia.....	1903	234	.....	.....	.....
Colony.....	1904	3,511	14.5	129,603	*50,622
Natal.....	1904	744	7.1	54,361	73,066
Transvaal.....	1904	1,335	9.9	.....	.....
Orange.....	1904	597	15.5	.....	.....
British Africa.....	1903	292	.....	.....	.....
German Africa.....	1903	1,168	.....	.....	.....
French Africa.....	1904	784	.....	.....	.....
Italian Africa.....	1904	17	.....	.....	.....
Portuguese Africa.....	1903	616	.....	.....	.....
Australia, etc.:					
Victoria.....	1904	3,383	28.0	200,581	59,328
New South Wales.....	1904	3,281	21.9	205,797	62,749
South Australia.....	1904	1,901	51.5	71,529	.....
Queensland.....	1904	2,927	56.7	101,650	34,718
Tasmania.....	1904	620	34.7	18,900	*40,912
Western Australia.....	1904	2,144	94.4	43,584	*28,284
New Zealand.....	1904	2,403	28.8	100,702	43,253

Notes. * Financial statement for 1903. † Austria, \$128,314; Hungary, \$74,056. ‡ Russia, \$78,553; Finland, \$32,189; § State railroad only. || Financial statement for 1899.

Railway Passenger Stations of the World. While there are resemblances between the facilities provided for railway passenger traffic in large cities and at important railway centres in various parts of the world, there are also distinct differences, due to the varying conditions and to the diverse general methods in vogue in the United States and foreign countries.

Generally speaking, large passenger stations may be classified into the following types:

First.—Terminal stations at or near the level of the adjacent streets, such as the existing Grand Central Station, New York; the Union Station, Saint Louis; the North and South Union Stations, Boston, Mass.; the Liverpool Street, Euston; Great Central, Victoria, etc., London, and Frankfort, Germany.

Second.—Terminal stations elevated above or partly above the streets, such as the Jersey City Station of the Pennsylvania Railroad, Jersey City, N. J.; Broad Street Station, Philadelphia; Waterloo and Saint Pancras, London; Saint Lazare, Paris; and the Central Station, Antwerp.

Third.—“Through” stations at street level, such as the Indianapolis Union Station and the Omaha and Saint Paul stations in the United States, and the Hanover Station, Germany.

Fourth.—Terminal and “through” stations combined, (a) at street level; (b) above it; (c) below it; and (d) partly above and partly below street level, such as (a) Buffalo, N. Y.; (b) Cologne, Germany; (c) proposed Pennsylvania Railroad Station, New York, and Waverly, Edinburgh; and (d) New Union Terminal, Washington, D. C., Queens Street, Glasgow, Scotland, and Dresden, Germany.

Table I. shows certain features related to operation, and is made up from a recent (1903) investigation of six large passenger stations of the United States, representative of the best practice.

SPECIAL INFORMATION RELATING TO SIX (6) LARGE UNITED STATES PASSENGER STATIONS.

ITEMS	Maximum	Minimum	Average
Train room			
Number of tracks.....	32	11	20
Scheduled trains per track in 24 hours.....	32.6	7.4	23
Scheduled trains per track busiest hour.....	2.8	1.2	2.2
Passengers per foot width of all platforms in 24 hours....	446	236	337
Trains			
Scheduled trains 24 hours			
Through.....	249	46	151.8
Suburban.....	580	80	275.3
Total.....	829	191	427.1
Scheduled trains in busiest hour			
Through.....	38	3	17
Suburban.....	50	2	26
Total.....	81	27	43
Maximum No. of trains in 24 hours.....	854	213	494.3
Maximum No. of trains in 1 hour.....	97	31	46.6
Passengers			
Average number per scheduled train			
In 24 hours.....	178	80.8	115
In busiest hour.....	251	100	188

RAILWAY PASSENGER STATIONS

ITEMS	Maximum	Minimum	Average
On scheduled trains in 24 hours			
Through	22,000	4,566	13,641
Suburban	33,839	16,701	24,509
Total	80,318	21,267	45,820
On scheduled trains in busiest hour			
Through	3,557	709	1,866
Suburban	6,092	2,000	4,581
Total	7,991	4,000	6,448
Maximum in 24 hours	200,000	34,598	104,195
Waiting room			
Maximum number of passengers per square foot of area	7.9	1.9	5.6
Average number of passengers per square foot of area	4.4	1.1	3
Concourse			
Area sq. ft.	60,000	14,814	26,657
Width of concourse	89'	35'	53.3'
Width of gates to trains	11.7'	3.5'	8.3'
Total width of all exits	162'	46'	96.5'
Passengers in 24 hours			
Per sq. ft. of area	3	1	2
Per foot of exit	1,076	284	556
Maximum passengers in 1 hour			
Per 10 sq. ft. of area	10	4	6
Per foot of exit	221	87.1	165
Toilet room			
Passengers in 24 hours per fixture			
W. C.	2,333	686	1,227.3
Basins	7,000	1,933	3,724.1
Urinals	3,878	863	2,406.3
Booths			
Number of telephones	14	1	7
Parcel			
Area sq. ft.	1,625	195	614
Lineal foot of shelving	2,294	50	837
Number of parcels in 24 hours	2,200	2,000	2,100
News — Area sq. ft.	480	180	337
Flowers — Area sq. ft.	500	15	173
Confectionery — Area sq. ft.	500	25	241
Cigars — Area sq. ft.	520	200	360
Restaurant			
Seating capacity			
Lunch counter	185	38	77
Dining room	330	42	20
Passengers in 24 hours			
Per sq. ft. of area	70	4	17
Per seat	1,108	115	305
Cabs			
Area sq. ft. cab stand	16,320	2,952	880
Lineal feet platform at cab stand	250	40	159
Baggage			
Pieces in and out in 24 hours			
Average	5,000	1,200	3,675
Maximum	12,000	1,500	7,198
Pieces per train	16	3	10
Number of passengers per piece	35	8	15
Area per piece sq. ft.	12	2	7
Pieces per lin. ft. of counter	100	18	64
Postal matter			
Tons in 24 hours			
Average	315	12	169
Maximum	350	23	183
Area sq. ft.	12,640	720	3,552
Area per ton, sq. ft.	72	12	43
Lineal feet platform	112	4	45
Scales	1	1	1

There are certain features that do not appear in this table. For example, in Paris it is the custom of the people to go out of the city in large numbers on Saturday and Sunday, especially in the summer time, and, to accommodate this immense crowd, the cars of the Western Railroad running out of the Saint Lazare Station are double-decked. On these days, the facilities of this station are taxed to their utmost and far

beyond the ordinary suburban business, which is always very great, particularly since the line was built crossing the Seine to the Champ de Mars.

To facilitate the rapid handling of traffic in the station, the train arriving with its load of passengers is not hauled out to allow the locomotive to pass out, but it remains on the arriving track while it is uncoupled and moved and turned by a combined traverse and turntable, and passes out of the station on an adjacent service track to the water-tank and coal-shutes, and then backs down to its train, couples on, and is ready to haul it out, head on, as soon as it is loaded. The side doors of the cars facilitate unloading and loading, so that the train is ready to be pulled out loaded by the time the engine is coupled on. This plan saves time, saves movements of trains and permits the locomotive to travel head-on whether coming in or going out.

This same plan of car doors in Great Britain facilitates egress and ingress. The writer timed the egress of 500 passengers from an arriving train at the Caledonian Railway Station, Glasgow, and recorded *ten seconds* as the time to wholly empty the train from the instant it stopped at the platform. The Illinois Central World's Fair trains in Chicago in 1893 adopted the same plan with great success in the prompt handling of large crowds. In London there is also an immense traffic on certain days, such as Bank Holiday, when all station facilities are taxed to their utmost.

There are other movements, also, to be taken into consideration in estimating the vast amount of work done at important railway stations. Empty trains called "drafts" or "carriage" trains must be hauled in from the storage yards, and hauled out empty to them. The locomotive which brings in the train must pass out to the round house. To give an idea of these extra movements, the following is quoted from the latest time tables of the South Union Station, Boston, Mass., and the Grand Central, New York:

SOUTH UNION STATION, BOSTON, MASS.

RECAPITULATION	Week-day trains
B. & A. R. R.	216
N. Y., N. H. & H. R. R.	
Providence Division	310
Plymouth Division	222
Midland Division	92
Grand Total	840
Regular trains	840
Drafts to and from storage yards	389
Light engines to and from engine houses	367
Total movements to and from terminal	1,596

GRAND CENTRAL STATION, NEW YORK.

RECAPITULATION	Week-day trains
N. Y. C. & H. R. R.	
Harlem Division	103
Hudson Division	129
N. Y., N. H. & H. R. R.	232
Harlem Line storage trains	125
Storage trains 46th Street Yard	109
Light engines to and from engine house	227
Total movements to and from terminal	345
Total movements to and from terminal	1,038

RAILWAY PASSENGER STATIONS

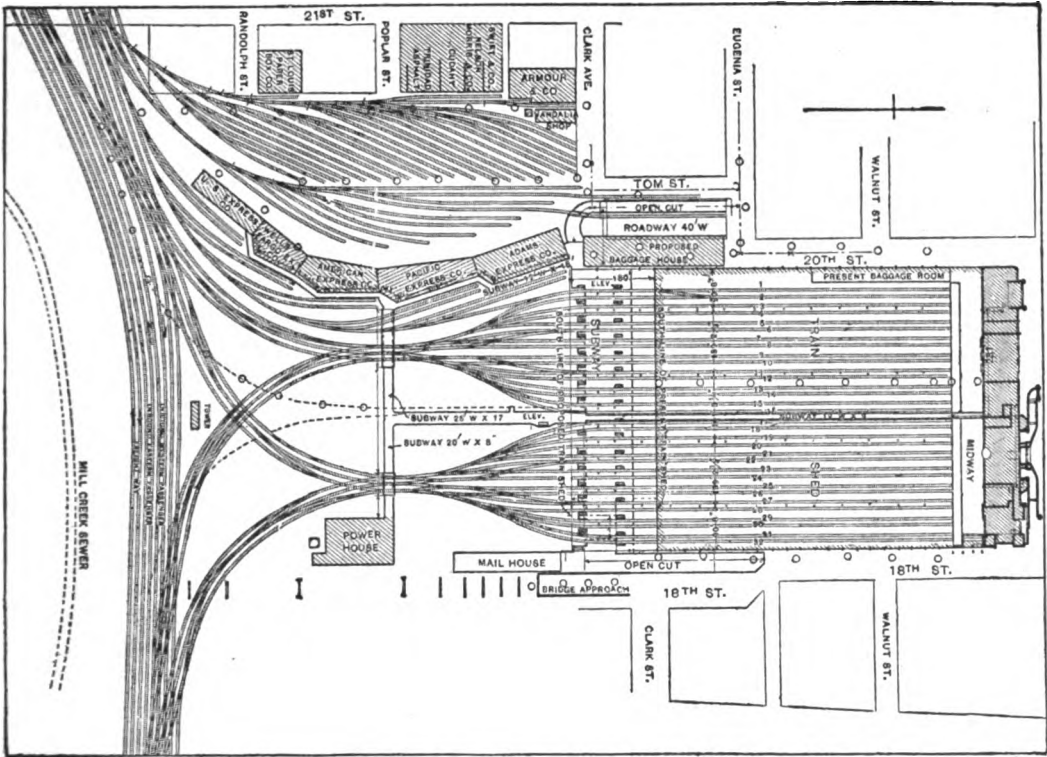


PLATE I.—Approach Tracks to Union Station, Saint Louis.

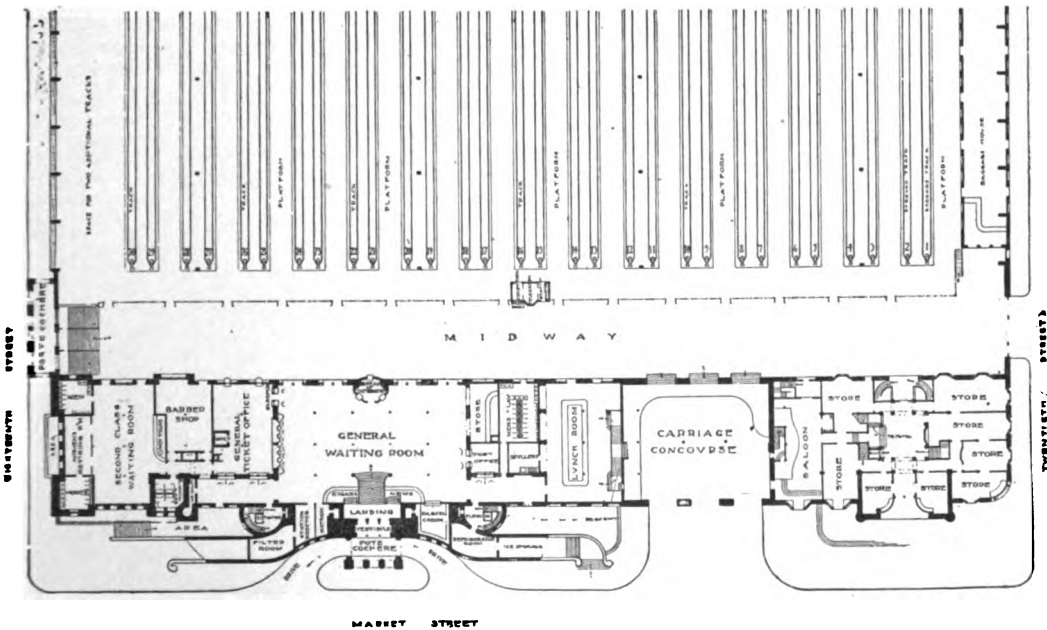


PLATE II.—Ground Floor: Midway and Tracks, Saint Louis.

RAILWAY PASSENGER STATIONS

As 88 regular scheduled trains arrive and depart during the busiest hour—5 to 6 P.M.—at the South Union Station, Boston, the number of movements required to accomplish this regular train work is very great, and the signal and interlocking mechanisms must necessarily be of the most approved kind.

It is quite common, however, to find a great number of regular train movements in stations that do not rank in size with the two above mentioned. In 1901 the Union Station, Saint Paul, Minn., was handling 202 regular trains on ten station tracks, of which 92 per cent had to be handled on six tracks, which required, between 8 and 9 A.M., 96 train movements, and all this was done with hand switches. This station is used jointly by ten important western railroads, and is a very busy station. One million pieces of baggage were handled in 1901—a daily average of 2,216. The average at the Grand Central Station, New York, in the same year was 2,654 pieces.

It is interesting to know something of the character of the approaches to large passenger stations over which so many trains pass daily,

and especially during the busiest hour. The information can best be given in a table where the work to be done and the facilities in the way of approaches are placed side by side.

The foregoing table is indicative of the traffic over approach tracks, but one should know the methods of handling it. All of the approach tracks may not be available for the traffic, and the ratio of station tracks to approach tracks, and of trains, as they appear in the table, may be very misleading, if we expect to learn from it just how many movements there are in the busiest hour over each track. One or more tracks may, for good reasons, be at that time comparatively idle, while another may be hot with wheels passing over it. The writer is enabled to show the actual number of movements over one of the approach tracks at the Grand Central Station, New York, on 21 March 1904. There are four approach tracks, and by the station time card there are in the busiest hour 34 arrivals and departures, or 8.5 trains per track in that hour, as per the above table.

There are 18 tracks in the station. This is at 45th Street. At 49th Street these tracks converge into four tracks, to enter the approach to the tunnel. They are numbered from east to west. Nos. 1 and 2 are south bound (toward the station) to 54th Street. (This road runs left-handed from a point some miles out into the station.) From 54th Street, south, for a distance of about 1,600 feet all south bound traffic is confined to track No. 2—No. 1 being used as a north bound track for shop trains and engines crossing over to tracks 3 and 4 at 54th Street.

This crossing point is the busiest piece of track on the approach, and for the hour between 8 and 9 A.M. there are 25 scheduled trains and 5 light engines south bound, and 8 trains and engines north bound, passing over this stretch of track—38 distinct movements in one hour, or one in every 1.6 minutes. This is not an exceptional performance, but daily practice. The information is given for the encouragement of any railway companies which contemplate a busy traffic over a small number of tracks.

It is possible in the space allowed to briefly give only the specially interesting features of one or two of each of the four classes, or types, referred to at the beginning of this article.

As illustrating the first type, namely, terminal stations at street level, the Union Station, Saint Louis, and the Frankfort Station, Germany, have been selected.

The second type, namely, terminal stations elevated or partly elevated above street level, is illustrated by the Reading Terminal, Philadelphia, and the Saint Lazare, Paris.

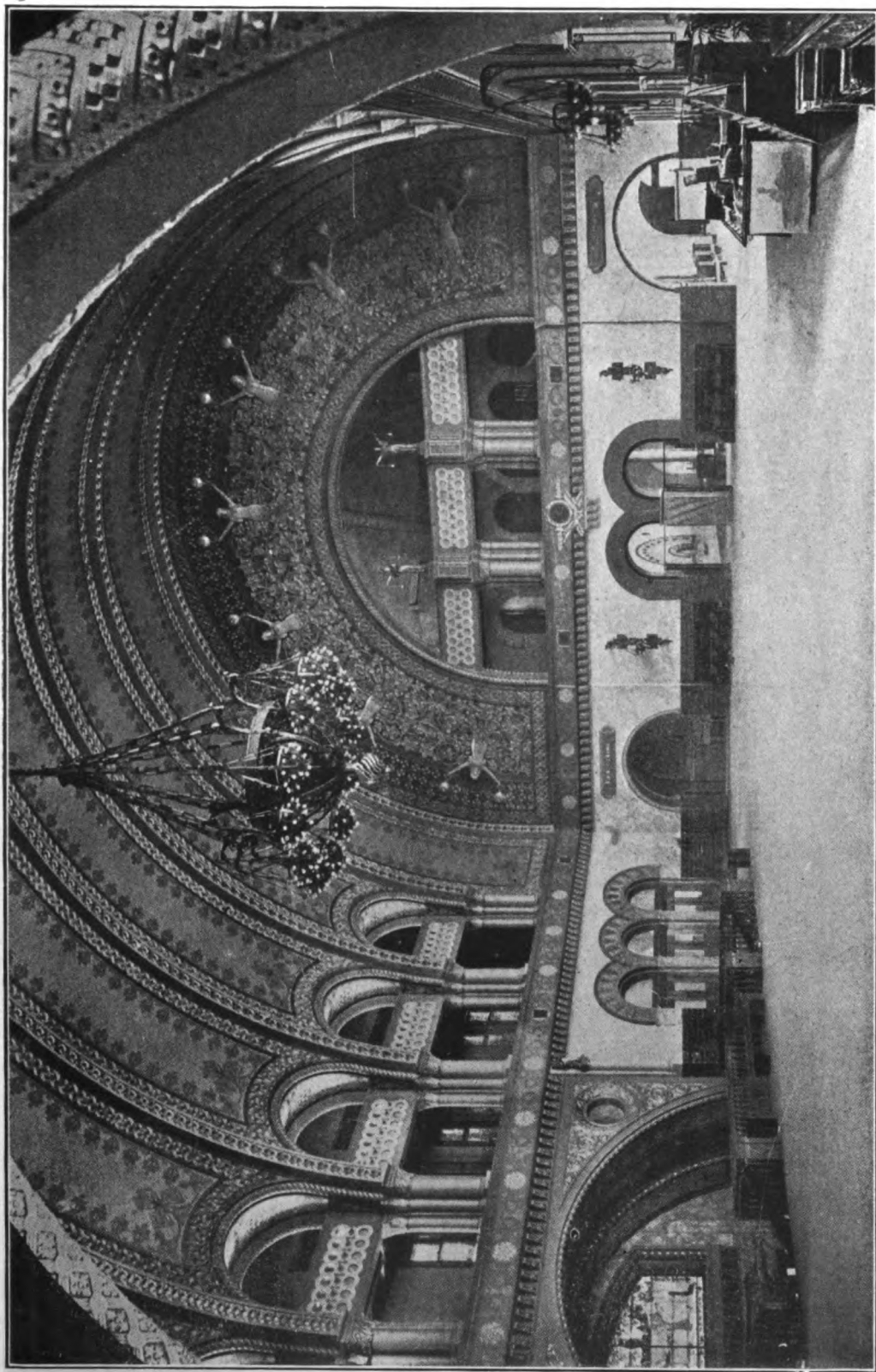
The third type, namely, through stations at street level, is represented by the Indianapolis Union Station.

The fourth type, namely, terminal and through stations combined, partly elevated or depressed, the Union Terminal, Washington, D. C., now under construction (April 1904), and the Dresden Station.

The Saint Louis Union Station is one of the largest in the world, for it has more tracks than any—30, with space for two more in the train shed, though not so many trains arrive and depart as with some other stations. Its traffic, however, is very important, as it is the terminus

TABLE SHOWING APPROACH TRACKS AND TRAFFIC ON THEM.

STATION	No. of approach tracks	No. tracks in station	Trains in 24 hrs.	Trains in 1 hr. maximum	Ratio between sta. tracks and approach tracks	Remarks
Jersey City, Pa.						
R. R.	5	16	281	25	3.2	Terminal
Reading Ter., Phila.	4	13	417	39	3.2	Terminal
North Union, Boston, Mass.	8	23	588	66	2.9	Terminal
Grand Cent., N. Y.	4	18	357	34	4.5	Terminal
South Union, Boston, Mass.	10	28	840	88	2.8	Terminal
L. S. & R. I., Chicago	4	9	182	2.2	Terminal	
Broad St., Phila.	6	16	470	43	2.7	Terminal
St. Louis, Mo.	6	30	237	39	5.0	Terminal
Union Depot, K. C.	4	13			3.2	Through
Erie R. R., Jer. City	2	10			5.0	Terminal
Central R. R. Jer. City	2	12			6.0	Terminal
D., L. & W., Hoboken	2	10			5.0	Terminal
West Shore, Weehawken	2	15			7.5	Terminal
Liverpool St., London	6	20	1094	83	3.3	Terminal (8 stubs So. 7 " No. 4 through.
Waverly, Edinburgh	4	19	1101	76	4.7	
London Bridge, London	8	25			3.1	Through
Waterloo, London	6	18	966	61	3.0	Terminal
Euston, London.	4	13			3.2	Terminal
St. Pancras, London	3	9			3.0	Terminal
St. Lazare, Paris.	6	31	1200	74	5.2	Terminal
Dresden, Ger.	4&6	14	808	49	1.4	{ From two directions thro. & ter. two dir.
Cologne, Ger.	6&2	14	300	13	1.8	{ Ter. & thro.
Frankfort, Ger.	11	18	478	31	1.6	Terminal
Hanover, Ger.	6&4	9			1.0	{ 6 one end 4 the other "through"



GRAND HALL, UNION STATION, ST. LOUIS

RAILWAY PASSENGER STATIONS

of 22 trunk lines and the trains are mostly through trains—very long and heavy. The trains approach from two directions, from the east over the two bridges that span the Mississippi River, and from the west by trunk lines from that direction. The original lay-out of the approach tracks had serious objections and radical changes are now being made to improve the entrance to the station.

Plate I. shows the new approach tracks, increasing the number from four to six. It will be seen that these approach tracks spread out into really four groups upon entering the immense train shed. The plan of the ground floor of the station, with the "Midway"—concourse—and the station end of the track, is shown on Plate II. A good idea of the interior may be had from Plate III.—showing "The Grand Hall." The station is owned by "The Terminal Railroad Association of Saint Louis." The roads using it form the proprietary company. The total first cost was \$6,500,000—the real estate costing \$4,500,000, and the buildings, etc., \$2,000,000. The cost of operation during the year 1898 was:

Rental	\$327,507.40
Less revenue from privileges.....	103,526.51
Net rental	\$223,980.89
Actual operating expenses and maintenance.	296,636.44
Total annual cost.....	\$520,617.33

The average charge per car for that year was \$1.58. The cost is apportioned among the roads using the station on a "wheelage" basis. This word must not be understood to mean wheels. It means cars (coaches), and the charge is on the basis of "equalized cars," as explained below. The following paragraph from the agreement between the Association and the various railways occupying the station will show clearly the method of apportioning the cost:

An accurate record shall be kept by the Terminal Company of all passenger, baggage, mail, express, sleeping, dining and special cars, in and out of the said Union Station during each calendar month, and said Railway Company shall pay said Terminal Company such proportion of said balance, as the number of such cars of said Railway Company in and out of the said Station, bears to the whole number of such cars in and out of lines using said Station facilities during the month; and in so ascertaining the number of such cars in and out, cars hauled in trains, the runs of which terminate within 37 miles of said Union Station, shall be counted as one-third part of a car, in all other cases as one car.

Frankfort-on-the-Main, Germany.—This station is owned by the Prussian government and the Hessian Ludwigs Railroad. It is really a street level station, the entire area in front and on the sides having been raised and embellished with grass plots, parks, and ample approach area. The general railroad approach differs from that at Saint Louis, as groups of tracks come into it direct. In order to prevent grade (level) crossings, the tracks approaching from different directions are at different levels for some little distance from the station, those coming in from lateral directions passing over those entering directly. The train shed is very large, but not equal to that of Saint Louis, being 551 feet by 610 feet with an area of 336,110 square feet, while the Saint Louis train shed is 606 feet by 700 feet, with an area of 424,200 square feet, and there are 18

tracks in the train shed at Frankfort. Plate IV. is a photographic view of the front of the station, and the train shed is seen in Plate V. The latter shows clearly the three great steel arches and the very substantial and permanent character of the wide platforms. The platforms of all large German stations are generally much more solid and are much wider than is often found in the United States.

The Reading Terminal, Philadelphia, is a characteristic station of the second type, elevated above the street. The train shed is one single metallic arch, three-pointed, hinged at the crown and covering the entire width of the tracks and platform, the width at springing line being 260 feet. The height is 88 feet, the length 502 feet. The total length of the station, including the head house, is 663 feet. The 13 tracks starting in the train shed reduce to 5, 350 feet from it. About 1,650 feet from it, they separate into two lines of two tracks each. The terminal yard is reached over an elevated structure, the plate girders bridging the street, or viaduct, on columns. This structure is half a mile long. The elevation of the rails is about 25 feet above the street level.

The station proper is in the second story of the head house—the ground floor being used for entrance, waiting rooms, ticket offices, baggage rooms, etc. The general and administrative offices are above the second story. The ground floor under the train shed is used for a large market, cold storage, and a refrigerating plant. The operating plant of the station is also here. The main waiting room on the second floor is very lofty, occupying two stories in height. There are also on this floor the dining, lunch and smoking rooms.

There are two large passenger elevators and a broad stairway. Each baggage room has two elevators (lifts) for baggage trucks to the train-shed floor. There are four more stories for offices. The floor of the elevated train shed is constructed of buckled plates carried by plate girders. There is a layer of cement over the plates and then one inch of Neuchâtel asphaltum. The cross-ties are laid in asphalt concrete, the platforms being made of the same material. The surface of the platforms is eight inches above the rails. Large frames of heavy hammered glass are built into the platforms to help in lighting the spaces underneath.

The building is a monumental structure, Italian renaissance in style, the exterior faces on the streets being of pink granite to the first story, and above that pink brick and cream terra cotta.

Some items of cost may be of interest. The head house cost \$36 per square foot of superficial area, or 23.1 cents per cubic foot of contents. This cost is for construction alone, and does not include heating, lighting, elevators, water supply, etc. The train shed, including foundations and apartments underneath, cost \$8.53 per square foot of surface covered. Plates VI. and VIa show respectively the ground floor, and section of train shed and foundations.

The Saint Lazare Station of the Western Railway, Paris, is an example of a terminal station, partly elevated and partly at street level. In front of the station the rue Saint Lazare is considerably below the level of the tracks, but on the eastern side the station tracks are at the level

RAILWAY PASSENGER STATIONS

of rue d'Amsterdam. The ground still rises and the rue de Londres is considerable above the level of the approach tracks and a little further on, at the rue Saint Petersburg, it requires a car lift of about 31 feet to raise the express freight from the track level to the street. There are 31 tracks in the station—27 for passenger trains and 4 for locomotives and other station service. About a quarter of a mile from the station, the tracks converge into six entrance tracks and pass through a tunnel about 1,000 feet long, and then through a deep cut. Three quarters of a

In front of the station and connected with it by a covered elevated gallery, is the Hotel Terminus, owned by the railway company. In the interior of the station, reached by several broad and easy stairways, is the Grand Hall "Pas Perdue," 630 feet long and 72 feet wide, from which exits lead to the waiting rooms and offices, etc., which are between this hall and the concourse. The baggage after being raised and registered, is raised to the track level on small trucks by means of movable inclined lifts hauled up by endless chains worked by hydraulic power.

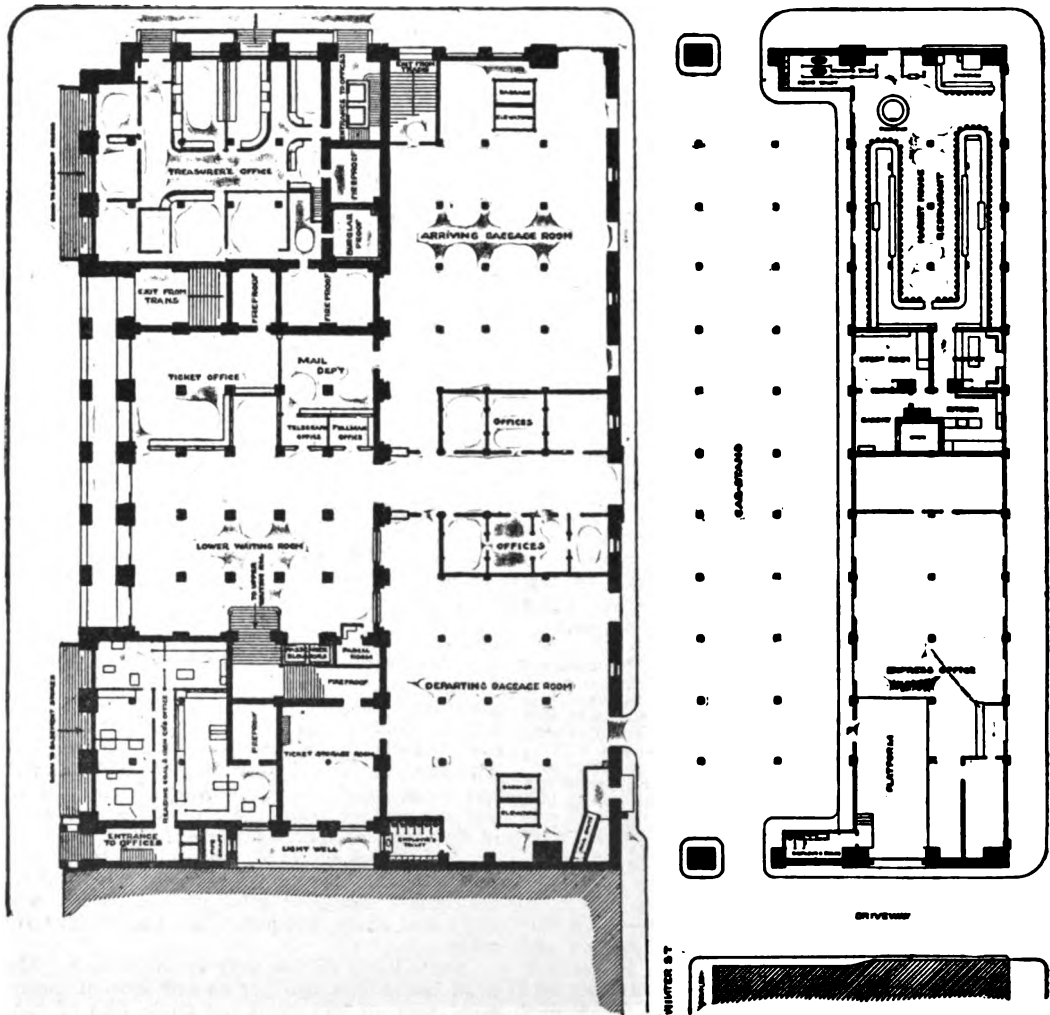
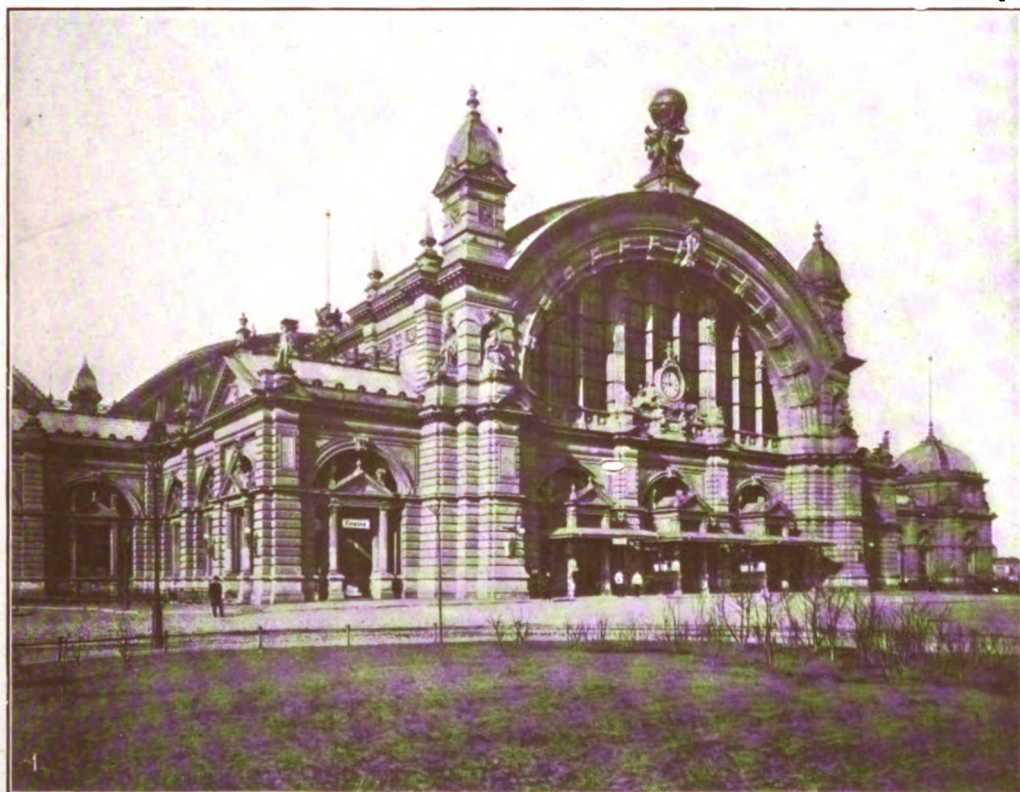


PLATE VI.—Ground Floor, Reading Terminal, Philadelphia.

mile from the station, the tracks diverge—two to the west and four to the west of north. Near the point where the lines separate, there is a very large terminal yard. This is one of the best equipped stations in the world. All parts of it, passenger and freight stations, shops, round houses and yards are fully supplied with hydraulic and electric power and light. It has 1,200 daily arrivals and departures of trains. Few exceed it in volume of traffic. It covers 27 acres. Of the various signal towers one commands the three groups of entrance tracks.

(See Plate VIII.) The traverse turntable is shown on Plate IX.

The Indianapolis Union Station is a typical station of the third type, "through" at street level. Five proprietary railway companies united (in 1888) their properties and organized this company. Nine other railways were admitted later as tenants with equal privileges to the five, all having a joint use of the station as well as of a belt line railway. The main building is an imposing and commodious structure, devoted almost exclusively to Union Station purposes.



1. Front View of Station, Frankfurt, Germany.

2. Train Shed of Frankfurt Station.

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Adjoining and extending past the head house in each direction, and open at both ends for through tracks, is a train shed 740 feet long and 200 feet wide, with nine passenger and two freight tracks. The entire station cost about \$1,000,000. The operating expenses per annum averaged in 10 years—1889-1898—\$60,000 or 23.7 cents per car. The annual fixed charges were about \$52,000, or 20.49 cents per car, to which should be added \$11,500 for track expenses, or 11.06 cents per car, making a total of about \$123,500, or 55.5 cents per car.

with hydraulic and electric power and appliances. The cost of the station with freight depots and other appurtenances, was \$5,315,000.

The Union Terminal, Washington, D. C., now under construction (April, 1904) is a good example of a terminal and through station combined—the fourth type. It is partly at street level and partly below the same. The six railroads, four from the south and two from the north, have thus far handled their passenger traffic at two stations at a considerable distance from each other, one near Pennsylvania Ave-

THIRTIETH STREET

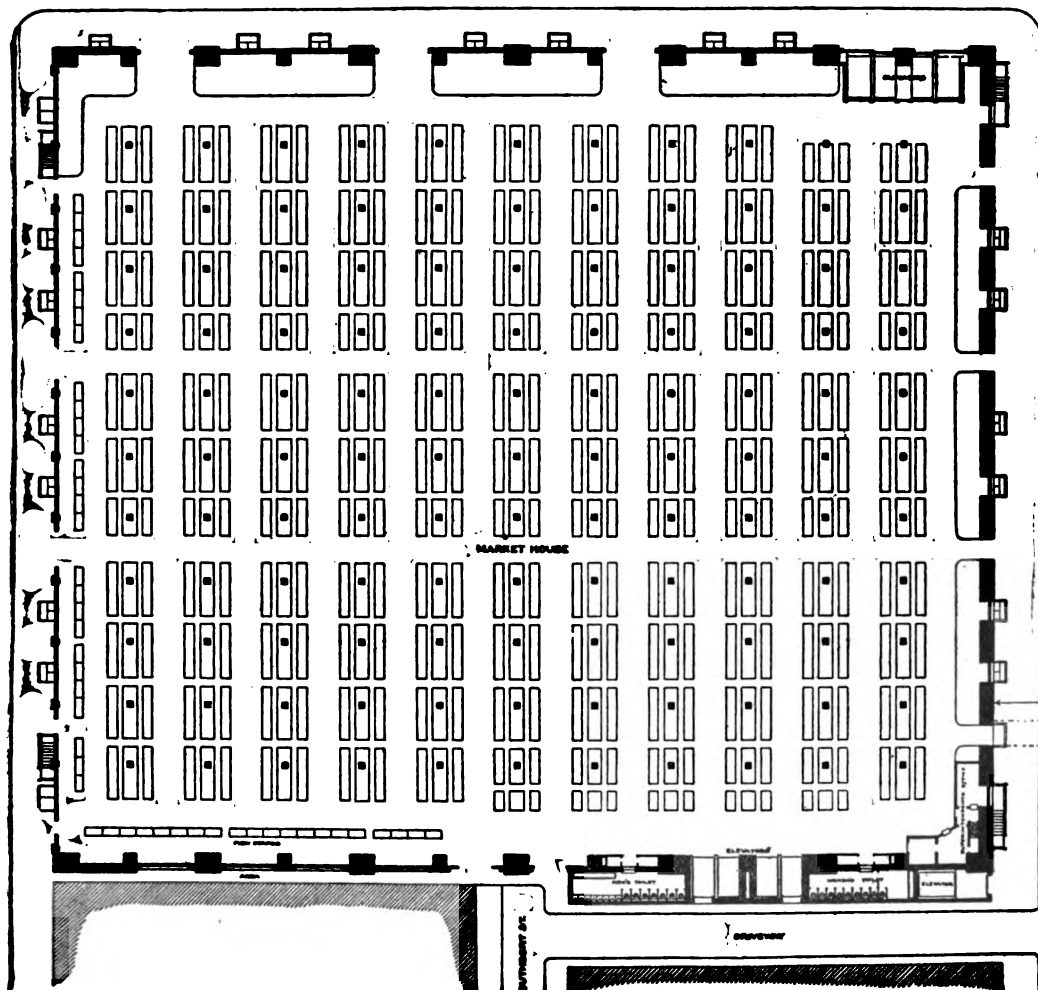


PLATE VIa.—Market House, Reading Terminal, Philadelphia.

The North Station, Hanover, Germany, is an excellent example of a continental through station at street level. Hanover is an important city of Central Germany on through lines from Frankfurt to Hamburg and Bremen, and from Cologne to Berlin. Four important roads occupy the station. The general plan comprises a commodious head house 566 feet long and 92 feet wide, and, back of it and attached to it, a train shed of about the same length, 289 feet wide, with nine tracks. The station is furnished

nue at 6th Street and one near the Capitol.

The new station is to be near the Capitol. The Philadelphia, Wilmington and Baltimore Railroad reaches it by a connection with its main line entering Washington, and leaves it from the low level by means of a double track tunnel passing under Capitol Hill near the Library of Congress, by which the roads from the south will reach the station. There are 11 through tracks at the low level and 18 terminal stub tracks at street level—five of those above and

RAILWAY PASSENGER STATIONS

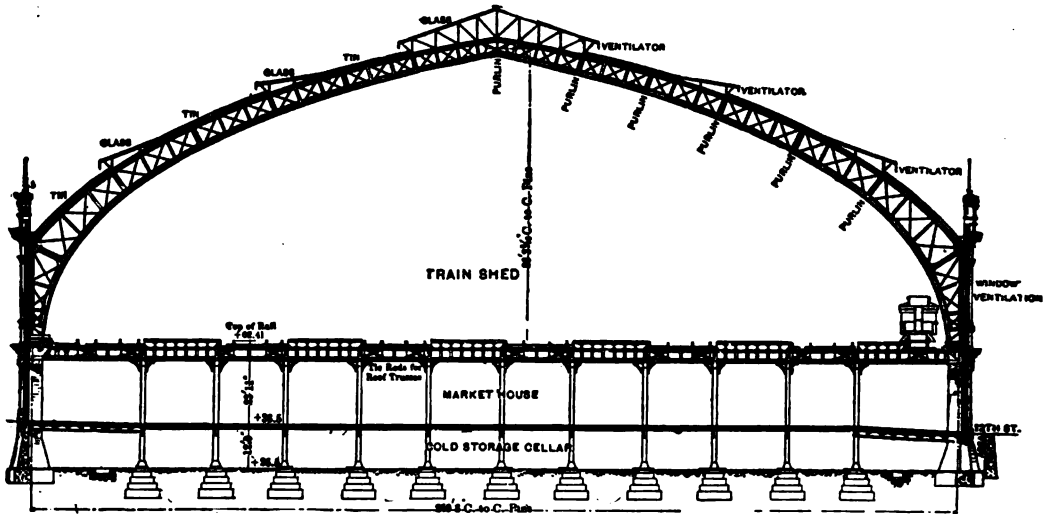


PLATE VII.—Cross Section of Train Shed Looking South, Reading Terminal, Philadelphia.

the same number below will be used for baggage tracks. Without going into details, certain interesting features should be referred to. (See Plate X.)

The general government participates in the station by contributing about \$4,600,000 toward the elimination of grade (level) crossings and towards the new plaza. It is estimated that the cost of the entire improvement will be about \$14,000,000.

The station building proper is about 620 feet long, to be built in white marble and granite. The three entrance arches are 50 feet high, lead-

ing into a vaulted open air vestibule. The arches at the end are for carriages, one arch being for the use of government officials, and leading to a suite of apartments for the exclusive use of the President of the United States and the guests of the nation.

Attention is called to the very large size of some of the rooms. The general waiting room is 128 feet by 236 feet and 90 feet high, covered by a Roman barrel-vaulted roof. The concourse is also of extraordinary dimensions, 80 feet by 745 feet, the whole width on both sides of the separating fence being 130 feet. The

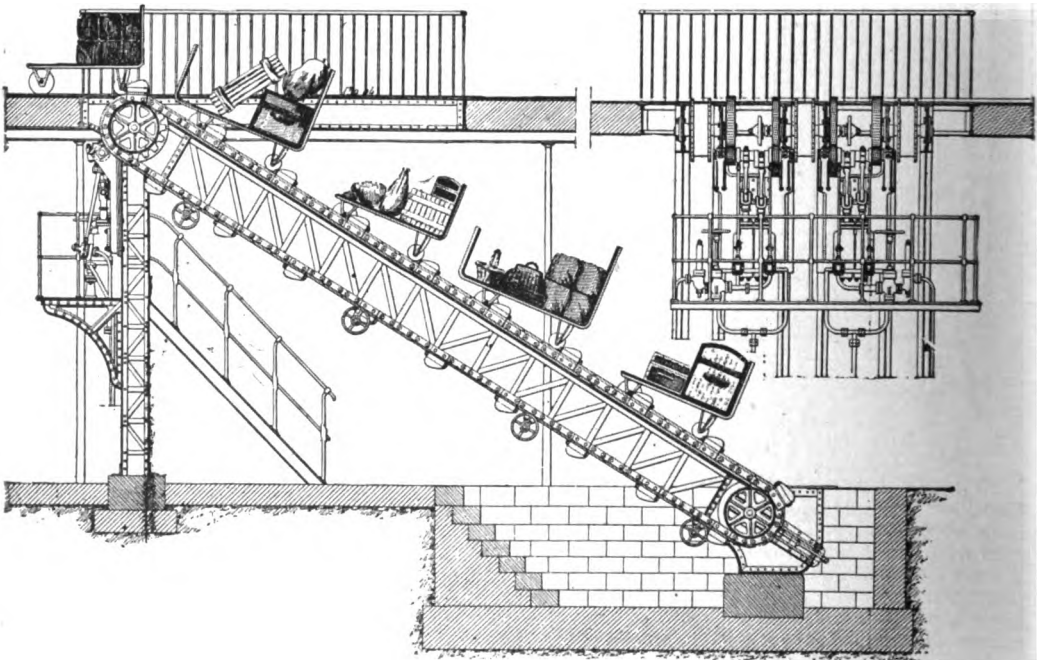


PLATE VIII.—Inclined Baggage Carrier, Saint Lazare, Paris.



INTERIOR VIEWS OF STATION, DRESDEN, SAXONY.

RAILWAY PASSENGER STATIONS

platforms are covered by umbrella sheds, adapted to the mild climate of Washington. The platforms average 900 feet long and 21 feet wide, made of concrete laid in cinders, and faced with one inch of cement. Plate XI. shows the umbrella sheds.

The baggage is handled in the basement, reached by two driveways. There are four baggage subways, two longitudinal, 16 feet wide, the whole length of the building, and one transverse 60 feet wide at the station end, and one at the outer end of the platforms 20 feet to 42 feet wide. H Street, 80 feet wide, is carried under the station, and K Street, also, outside of the station.

Other interesting provisions are an invalid's room, offices of a resident physician, several mortuary chambers, dressing-rooms with bath, a Turkish bath and swimming pool. The northern approach is on a masonry viaduct crossing over all streets. There are eight tracks upon it.

The Waverley Station, Edinburgh, Scotland, is another interesting example of the fourth type, being wholly depressed, and partly through

of tasteful ornamentation within and without. It has all the numerous and special conveniences of the most modern United States stations, and one feature not often found in this country, and that is abundant station service—porters, waiters, etc., in which European stations are generally far in advance of stations in the United States. The station is everywhere brilliantly lighted by electricity and is always a model of cleanliness. There are two waiting-rooms for first and second-class passengers, and two for third and fourth, with several restaurants. There is a police station, branch post-office, telegraph, telephones, a physician always in attendance, with the usual other facilities. (See Plate XII.)

The foregoing descriptions and illustrations, and the tables and plates, are sufficient to give an idea of the facilities in the United States and in some other countries where large numbers of passengers are handled. The increase of passenger traffic in many large stations has compelled enlargement of facilities. Old stations, which a few years ago were considered ample, are now under reconstruction to avoid either the

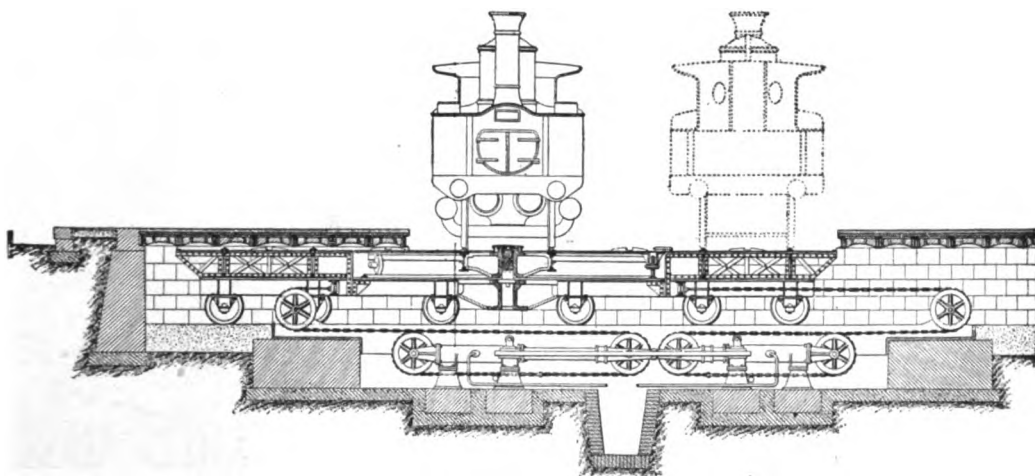


PLATE IX.— Combined Traverse Turntable, Saint Lazare, Paris.

and partly terminal. The cost of its construction, including property, was \$7,500,000. It was recently completed. The cost of operating it is about \$165,000 per annum. It has a large passenger traffic—630 daily arrivals and departures of trains and 40 in the busiest hour. There are four approach tracks on each end and both in tunnels. Through trains can pass through the station on each side on two through tracks, and there are 8 platform terminal tracks on the south end, and 7 on the north end. In general physical features the approaches and the station area are somewhat similar to those of the proposed Pennsylvania Railroad station in New York, reaching it from under the Hudson River and the East River.

The Dresden Station, Germany, is another European station of the fourth type worth noting. It has six terminal tracks at street level and eight through tracks above. This station, for architecture and for general convenience, cannot be surpassed. The materials of construction are stone, iron and glass with a profusion

of tasteful ornamentation within and without. It has all the numerous and special conveniences of the most modern United States stations, and one feature not often found in this country, and that is abundant station service—porters, waiters, etc., in which European stations are generally far in advance of stations in the United States.

In Chicago the Lake Shore and Michigan Southern Railroad and the Rock Island and Pacific Railroad have recently entirely rebuilt their joint station, raising their tracks 15 feet above the street level.

In Great Britain the large Caledonian Railway station in Glasgow, the principal terminal of that road in that city, is being greatly enlarged and improved.

Waterloo Station, London, one of the largest in the world, and with an immense traffic, has been found to be inadequate for its business and is being wholly rebuilt on an entirely different plan from the old station, which in the course of years had grown by additions which had destroyed entirely the unity of the original design.

In Paris in 1900 it was found necessary to bring the Orleans Railway farther into the city, and an approach several miles in length was built along the bank of the Seine below the

RAILWAY PASSENGER STATIONS

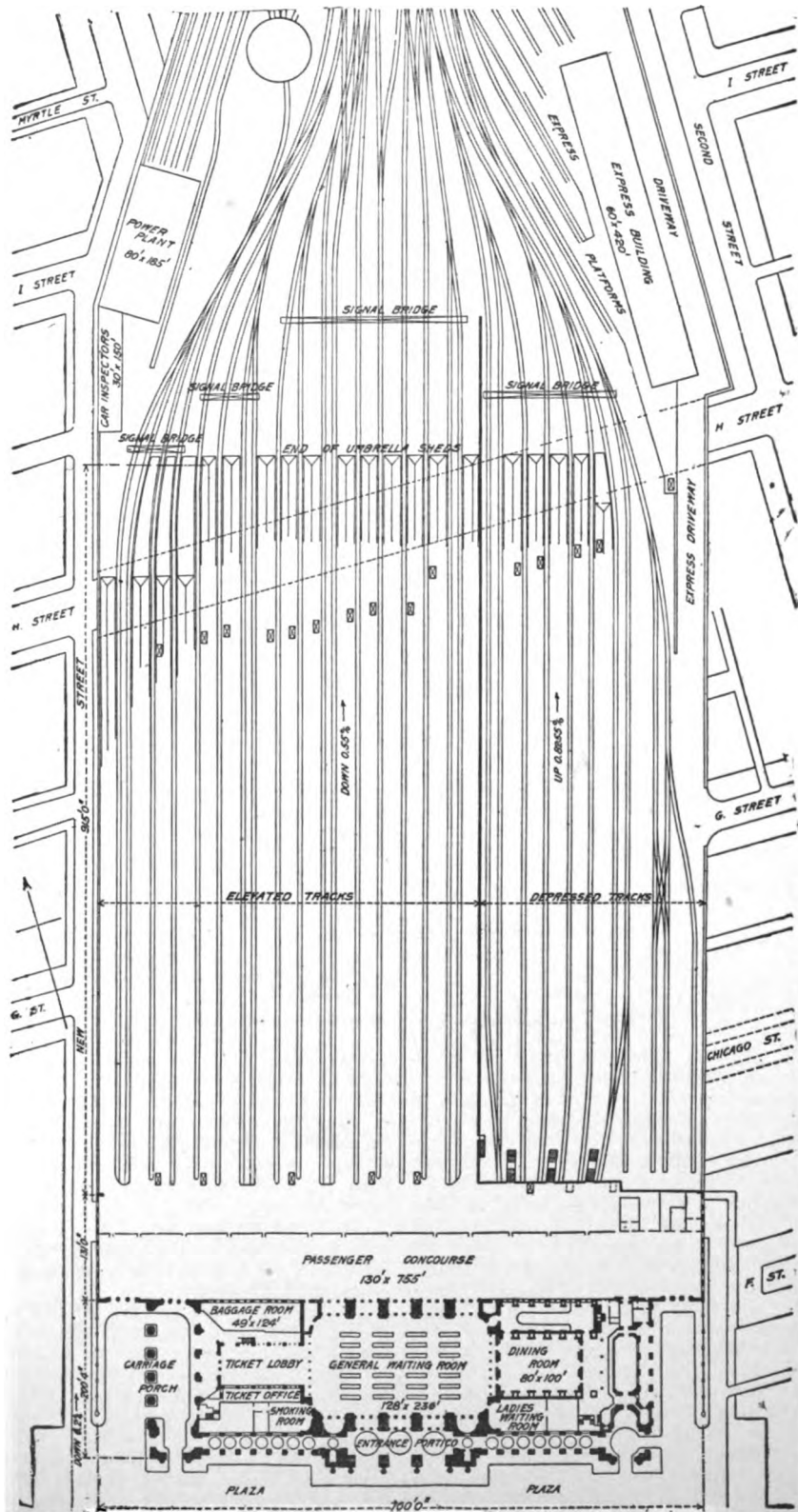


PLATE X.—Plan at Street Level. Union Terminal, Washington, D. C.

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street level to the Quai d'Orsay in the Exposition grounds, opposite the end of the Alexander III. bridge. The approach and the station tracks are entirely below the surface.

The new Gare de Lyons, the great terminal station in Paris of the Paris, Lyons and Mediterranean Railway, is approaching completion and on a scale far beyond that of the former station; in fact, the old station is entirely done away with.

One of the most important terminal works now under way in the world is the reconstruction of the Grand Central Station, New York. This station has had successive enlargements from time to time in the past to endeavor to meet the steadily increasing traffic, and it was only three years ago that very extensive interior changes were made in the station, throwing

lach und Seeliger-Schenorl und Von Seefeld, Hanover, Germany.

Union Terminal, Washington.—The 'Railroad Gazette,' New York, 4 Dec. 1903, and 15 Jan. 1904.

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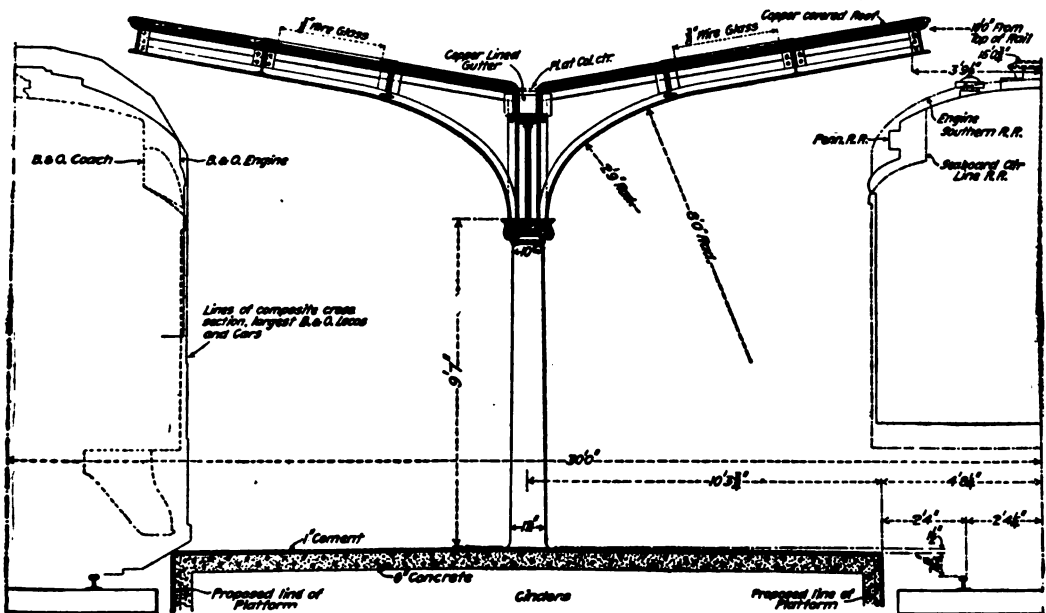


PLATE XI.—Cross Section of Umbrella Train Shed, showing Clearance Lines, Union Terminal, Washington, D. C.

the three waiting rooms which previously existed, into one large commodious and elegant room, concourse, etc., but the traffic has already outgrown these facilities. The company wisely decided to adequately prepare for its business, but, as to do this no ordinary modifications would meet the requirements, it was determined to raze the present station to the ground and build a new one, and while doing this to make certain other radical changes to meet new conditions and connections. The plans of the station and other facilities are not sufficiently advanced for description at the present time.

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RAILWAY POSTAL CARS

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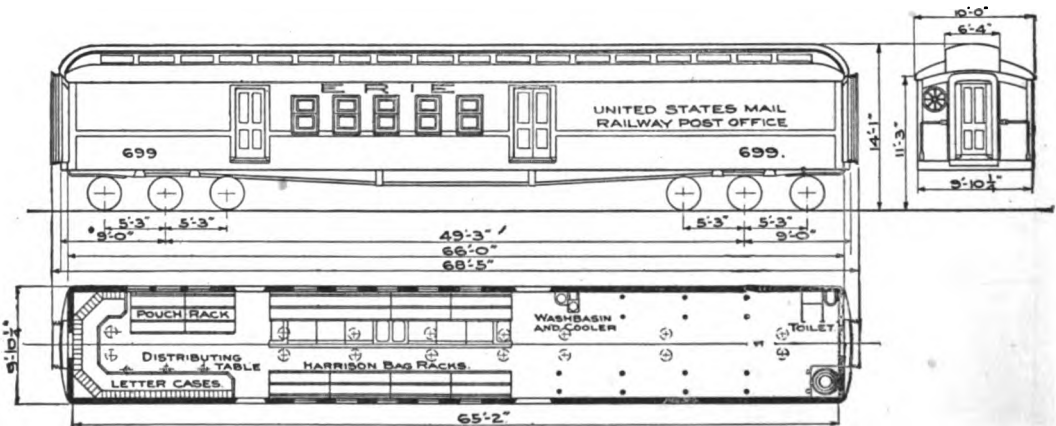
E. L. CORTHELL,
Civil Engineer, New York.

Railway Postal Cars, Steel. The all-steel postal car was first used by the Erie Railroad. The first of the type was built by the Standard Steel Car Company of Butler, Pa., and included in the exhibit of railway appliances incident to the International Railway Congress at Washington, 4-13 May 1905. It was also exhibited at Buffalo on 31 May 1905, at Cleveland on 2 June, and at Cincinnati on 5 June. The final exhibition was at Chicago on 7 June 1905, the car going into regular service that date on the Erie mail route between Chicago and New York.

which is a 5-inch air space. Then is a layer of steel flooring which is covered with a cork and cement composition $\frac{3}{4}$ -inch thick, and over this a thin maple wooden floor runs lengthwise with the car. In designing the car particular attention was paid to strengthening its ends, thereby obtaining the utmost resistance in case of collision.

The end sills are of pressed steel in channel form $\frac{3}{8}$ -inch thick, covered by $\frac{1}{2}$ -inch steel plates 12 $\frac{1}{4}$ -inches wide to which the steel flooring is riveted. The end plate at the top of the car is of $\frac{1}{4}$ -inch steel, 10 inches wide, in "L" shape with a 4-inch flange. The end uprights consist of two door posts, two end posts and two intermediates. All are made of angle iron securely riveted to the floor and roof. The end construction is therefore of extraordinary strength.

It was anticipated that the car would move noisily and be more difficult to heat in winter than the ordinary car, but these disadvantages have been largely overcome by the triple floors, the double lining, and the air space. The interior furniture conforms to that of the ordinary standard postal car, but all the woodwork has been covered with fireproofing. The steam heat is provided by the direct system, and there is also a Baker heater for emergency use.



The car is 65 feet long and weighs 114,440 pounds, less than 15 per cent. more than the 65 foot wooden postal car which weighs 101,700 pounds. The steel underframe is designed so that the weight principally rests on two center sills. These sills are 16 inches apart and are made of $\frac{3}{8}$ -inch steel plate, built up as a wedge shaped box girder, with a maximum depth of 22 inches in the center of the car and a minimum depth of 13 inches at each end. The framework of the body of the car is made of $\frac{1}{4}$ -inch steel plates, the roof of $\frac{1}{8}$ -inch steel plates, all riveted together as in boiler construction; the door and window frames being reinforced by heavy steel plating. The interior of car is lined on the sides, roofs, and ends with composition board $\frac{3}{8}$ -inches thick, with a $\frac{3}{4}$ -inch layer of hair felt against the steel sides and 2-inch air space between hair felt and composition board. The floor of the car is of $\frac{1}{4}$ -inch steel plates securely riveted and built up as follows: At the bottom a wooden deafening floor $\frac{3}{4}$ inch thick is covered with a layer of hair felt above

Nineteen acetylene gas lights from a plant furnished by the Commercial Acetylene Company aggregate a total of 712 candle power, in contrast with the 400 candle power of the ordinary postal car.

The steel postal car was the conception of Mr. F. D. Underwood, President of the Erie Railroad, and was adopted on that line to add to the safety of the United States mail agents and postal clerks whose runs are over the Erie Railroad. The steel car has, beyond question, a resistance so much greater than that of the wooden car that the danger of telescoping is practically eliminated, no matter how great the shock. The danger of fire is also eliminated in the case of the steel car, the interior being nearly and the exterior quite fireproof. Even under the most strenuous conditions of operation, an impact sufficient to buckle or crumple the steel postal car is almost beyond imagination. Even if a steel car were to buckle because of the great resistance, the crumpling would be slow and free from splinters and fire. The occupants

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could hardly be seriously injured, at least not from the causes which, in the wooden cars, are their greatest danger,—splinters, fire, and scalding steam from the locomotive.

That the steel postal car adds largely to the safety of the postal clerks, was thoroughly demonstrated in the accident to the Erie Railroad train No. 8, one mile west of Burbank, Ohio, on 23 July 1906. This steel postal car, number 699, was next the engine and the train was running about 45 miles an hour when the derailment occurred. The car rolled down a 20-foot embankment and turned over on its side, stopping about 30 feet from the track. No one of the three occupants was seriously injured, and the car received the roughest usage with practically no damage.

C. S. SIMS,
Assistant to President, Erie Railroad.

Railway Receiverships and Reorganizations. It would scarcely be expected that an industrial institution of such magnitude as the American railway system could develop within the comparatively short period since the year 1830 without some evidences of friction. The promoters of railway enterprises have not always thoroughly understood the conditions of the industry nor the commercial needs and possibilities of the regions served by their lines; investors in railway securities have sometimes been too greedy of large and immediate gains and too reluctant to lay, through abstinence from immediate returns, a solid foundation for future prosperity; legislatures have too frequently and too quickly passed from the extreme of unduly fostering railway construction to that of drastic anti-railway enactments. In consequence of these and many other misconceptions and mistakes many railway corporations have, at different periods in their history, been unable to provide during times of extreme business activity and prosperity for the regular recurrence of industrial depression. Earnings during good times have been wholly distributed among security-holders and no surplus accumulated for the period of relatively bad times certain to follow. Even the normal depreciation of the property has, in some instances, been underestimated or even utterly neglected, renewals and repairs have not been made or if made they have been charged to capital and not

to expenses, where they belong. Such practices, supplemented in their evil consequences, by a good deal of positively vicious restrictive legislation, could lead to but one result, and that the bankruptcy of the corporations chiefly suffering from them. Indeed a study of the rapid changes in traffic conditions during successive years shows that even the wisest management might well have been perplexed as to how best to prepare for the exceedingly uncertain future. The statement at the foot of preceding column shows the aggregate transportation performed by the railways of the United States during each fiscal year from 1889 to 1902 inclusive, as measured in passenger miles and freight ton-miles.

It must be perfectly obvious that unless such heavy decreases in traffic as occurred after 1893 could be offset by advances in charges sufficient to prevent corresponding decreases in revenue and if they had not been forestalled by the accumulation of a surplus during more prosperous times, the consequences must involve reductions in the payments to security holders. This is precisely what occurred and in the case of those companies whose earnings during the more prosperous period had barely sufficed to meet interest charges, leaving nothing for dividends to stockholders, the reduced ability to pay interest on bonds frequently led to insolvency and the appointment of receivers. It should be observed, in passing, that in spite of the 15 per cent reduction in the volume of passenger traffic between 1894 and 1895 the average revenue per passenger per mile increased barely one half of one mill and that while the volume of freight traffic decreased over 14 per cent between 1893 and 1894 there was an actual decrease in the average receipts per ton per mile. Although the volume of freight business done in 1893 was not again equaled until 1898, each successive year from 1893 to 1899 shows a reduction in the average ton-mile receipts, the aggregate decrease being 1.54 mills, equal, on the basis of the business of 1893, to \$144,125,692. The following table, showing the par value of the railway stocks and bonds, which received no return in dividends or interest, during the years named, indicates the exceeding vulnerability of railway corporations in the face of decreasing traffic and revenue:

YEAR	Passenger miles		Ton-miles	
	Number	Per cent of previous year	Number	Per cent of previous year
1889....	11,553,820,445	....	68,727,223,146	....
1890....	11,847,785,617	102.54	76,207,047,298	110.88
1891....	12,844,243,881	108.41	81,073,784,121	106.39
1892....	13,362,898,299	104.04	88,241,050,225	108.84
1893....	14,220,101,084	106.48	93,588,111,833	106.06
1894....	14,280,445,893	100.42	80,335,104,702	85.84
1895....	12,188,446,271	85.30	85,227,515,891	106.09
1896....	13,049,007,233	107.06	95,328,360,278	111.85
1897....	12,256,939,647	93.93	95,139,022,225	99.80
1898....	13,379,930,004	109.16	114,077,576,305	119.91
1899....	14,591,327,613	109.05	123,667,257,153	108.41
1900....	16,039,007,217	109.92	141,599,157,270	114.50
1901....	17,353,588,444	108.20	147,077,136,040	103.87
1902....	19,689,937,620	113.46	157,289,370,053	106.94

YEAR	Stocks, receiving no dividends		Bonds,* receiving no interest	
	Par value	Per cent of total	Par value	Per cent of total
1889	\$2,621,439,792	61.67	\$775,851,795	18.19
1890	2,811,526,552	63.76	.....	....
1891	2,654,258,391	59.64	473,925,526	9.90
1892	2,807,403,326	60.60	777,719,420	15.56
1893	2,859,334,572	61.24	743,015,132	14.39
1894	3,066,150,094	63.43	914,757,607	17.29
1895	3,475,040,203	70.06	890,561,460	16.71
1896	3,667,503,194	70.17	860,559,442	16.26
1897	3,761,092,277	70.10	867,950,840	16.59
1898	3,570,155,239	66.26	852,402,622	15.82
1899	3,275,509,181	59.39	572,410,746	10.45
1900	3,176,609,698	54.34	378,937,806	6.78
1901	2,828,991,025	48.73	361,905,203	6.23
1902	2,686,556,614	44.60	294,175,243	4.89

* Exclusive of equipment trust obligations.

When railway companies are unable to pay the interest on mortgage bonds it is the practice for the trustees under the mortgage, or

RAILWAY RECEIVERSHIPS

other parties in interest, to apply to a court of competent jurisdiction for a receiver to manage the property in the interest of the bondholders. Such receiverships are not always unfriendly to the management in whose charge the corporation became insolvent. Indeed "friendly" receiverships instituted for the purpose of perpetuating the existing management and its policies in spite of its inability to pay interest, and to relieve the property of the burden of such payments in order that it need not be suffered unduly to deteriorate on account of the impossibility of meeting both interest and the cost of ordinary repairs and replacements out of revenue, have been frequent. So liberal has been the policy of some courts in this respect that the device of operation through receivers has even been found a convenient means of providing for the rehabilitation of properties that have been permitted to run down in order to keep up interest and, in some cases, dividend payments. The utility of this device is enhanced by the privilege, frequently allowed, of raising funds for repairs and even for necessary improvements by issuing "receiver's certificates," which are obligations having priority over everything except wages. The extent of the American railway mileage in the control of receivers has at times been appalling, but it is now very much reduced.

The preceding table shows the total railway mileage of the country, and the number of railways with their mileage, in the hands of receivers on 30 June of each year from 1894 to 1902, inclusive.

Nothing could be more significant of the increased prosperity of the American railway system, which has accompanied the general revival of business that has followed the depression of 1893-6, than the decrease shown by the foregoing, in the proportion of the railroad mileage of the country controlled by receivers from nearly one quarter of the whole in 1894 to less than three quarters of one per cent eight years thereafter. The release of railway property from the control of receivers is commonly accompanied by a "reorganization" or readjustment of its capitalization, and this may be secured with or without foreclosure. When reorganization is accomplished without a foreclosure of any of the mortgages standing against the property, it is by agreement among the owners of its various grades of securities. For the purpose of effecting a reorganization it is the practice to appoint committees representing the holders of the bonds or of the bonds and stocks, if it is thought practicable to permit the latter to participate in the reorganization. These committees devise reorganization plans which usually involve the surrender of some or all of the old securities and the acceptance in exchange of new securities bearing lower rates of interest or having a less absolute claim to regular returns or occasionally, of a lower aggregate par value. In several reorganizations the stockholders have been compelled to meet assessments on penalty of forfeiture of interest and in a few cases even owners of bonds have been assessed. When the holders of all grades of securities can be permitted to share in the reorganization and divergent interests can be reconciled so as to obtain an agreement, a foreclosure is unnecessary. It has frequently hap-

YEAR	Total mileage in the United States	In the control of receivers		
		Mileage	Per cent of total	Number of roads
1894.....	178,709	40,819	22.84	192
1895.....	180,657	37,856	20.95	169
1896.....	182,777	30,475	16.67	151
1897.....	184,428	18,862	10.23	128
1898.....	186,396	12,745	6.84	94
1899.....	189,295	9,853	5.21	71
1900.....	193,346	4,178	2.16	52
1901.....	197,237	2,497	1.27	45
1902.....	202,472	1,475	.73	27

NUMBER OF RAILWAY CORPORATIONS IN HANDS OF RECEIVERS, 1876 TO 1903.

YEAR	Receivers appointed			Sold under foreclosure		
	Number of roads	Mileage	Par value of stocks and bonds	Number of roads	Mileage	Par value of stocks and bonds
1876.....	42	6,662	\$467,000,000	30	3,840	\$217,848,000
1877.....	38	3,637	220,294,000	54	3,875	198,984,000
1878.....	27	2,320	92,385,000	48	3,906	311,631,000
1879.....	12	1,102	39,367,000	65	4,909	243,288,000
1880.....	13	885	140,265,000	31	3,775	263,882,000
1881.....	5	110	3,742,000	29	2,617	137,923,000
1882.....	12	912	39,074,000	16	867	65,426,000
1883.....	11	1,990	108,470,000	18	1,354	47,100,000
1884.....	37	11,038	714,755,000	15	710	23,504,000
1885.....	44	8,386	385,460,000	22	3,156	278,394,000
1886.....	13	1,799	70,346,000	45	7,687	374,109,000
1887.....	9	1,046	90,318,000	31	5,478	328,181,000
1888.....	22	3,270	186,814,000	19	1,596	64,555,000
1889.....	22	3,803	99,664,000	25	2,930	137,815,000
1890.....	26	2,963	105,007,000	29	3,825	182,495,000
1891.....	26	2,159	84,479,000	21	3,223	169,069,000
1892.....	36	10,508	357,692,000	28	1,922	95,898,000
1893.....	74	29,340	1,781,046,000	25	1,613	79,924,000
1894.....	38	7,025	395,791,000	42	5,643	318,999,000
1895.....	31	4,089	369,075,000	52	12,831	761,791,000
1896.....	34	5,441	275,597,000	58	13,730	1,150,377,000
1897.....	18	1,537	92,909,000	42	6,675	517,680,000
1898.....	18	2,069	138,701,000	47	6,054	252,910,000
1899.....	10	1,019	52,285,000	32	4,294	267,534,000
1900.....	16	1,165	78,234,000	24	3,477	190,374,000
1901.....	4	73	1,627,000	18	1,139	85,808,000
1902.....	5	278	5,835,000	18	693	39,885,000
1903.....	9	229	18,823,000	13	555	15,885,000

RAILWAY ROLLING STOCK

pened, however, that the lower grades of securities have had to be excluded from participation, and in these cases their rights must be "foreclosed" by appropriate legal proceedings culminating in sale "under the hammer." The statement on preceding page (compiled by the 'Railway Age') shows, for each of the years from 1876 to 1903, inclusive, the number of railway corporations for which receivers were appointed, with their mileage and the aggregate par value of their stocks and bonds. Similar data are also given concerning the railways sold at foreclosure sales.

While it is not probable that railway corporations will hereafter escape entirely from the misfortunes and mistakes which result inevitably in insolvency, it is gratifying to note evidences of greater wisdom in financial management and to record the impression which appears wholly justified by the facts, that the record of insolvency shown for the worst years of the last great depression will never again be equaled in the railroad field.

H. T. NEWCOMB,
Author of 'Railway Economics.'

Railway Rolling Stock. Between the earliest days in the history of railways when everything was in the most primitive condition, and the immense developments of traffic of recent years, there has been a steady progress while railroad students have applied themselves to the solution of the problem how the increasing traffic could be handled most expeditiously and at the same time economically. One of the most potent suggestions toward the reduction of working expenses is that the rolling stock shall have greater capacity in order to reduce the proportion of dead weight carried. As a result of this, rails have to be made heavier, roadbed more durable, and everything entering into railroad construction more costly. A freight carload not long since was 12 tons, while maximum carloads now reach, for certain commodities, such as coal, 60 to 100 tons, and from 40 to 60 tons for ordinary commercial freight. Locomotives have increased in weight from 50,000 pounds to 300,000 to 400,000 pounds, and the limit is not yet reached. We are taking up rails weighing 50 to 60 pounds to the yard and are putting down rails ranging from 80 to 100 pounds. We are getting away from bridges which were built to endure a live maximum load of 3,500 pounds per lineal foot, and are building bridges designed for live loads of 7,000 pounds and more per lineal foot, and as a consequence, couplings and drawbars have to be stronger and heavier.

Railroads are consuming constantly increasing tonnages of iron and steel in proportion to their mileage, and this tendency will surely continue until the highest factor of efficiency and consequently the lowest possible ton-mile cost of haulage is reached. It is not merely a matter of replacing rails and bridges, locomotives, and cars with heavier ones when the old ones are worn out, but it is more frequently a case of discarding the old for the new before the old equipment has seen half the years of its intended service. Freight cars cannot be made much longer or wider than the present maximum as long as existing curves have to be negotiated, but they may be made higher, be-

cause the almost universal use of the air brake no longer makes it necessary to allow for the brakeman between the car roof and the overhead bridge or viaduct. Their carrying capacity is also being augmented by the substitution of steel for wood.

Changing railroad conditions make it difficult to estimate the life of locomotives, and of passenger and freight cars. There are many passenger coaches in use to-day which were built 30 or more years ago and are still in good condition, if not modern in appearance. The cars that were lightly built 25 years ago have no business in modern heavy trains. On short branch roads they serve their purpose. The custom now is to build with steel underframing like the Pullmans, so that it is almost impossible to injure them in a wreck.

The box car's life is shortest of all rolling stock, and this is owing largely to the changes in construction. The capacity of cars has increased from 40,000 to 80,000 or 100,000 pounds each, and usage is rougher. The use of the air brake has helped to preserve them, but it is hard service at the best in the present-day long, heavy trains. There are many box cars running, however, which have seen more than 25 years of service, and their life might be averaged at 20 years. There is no reason why the steel gondolas should not last 30 years or more, as there is less likelihood of their wearing out. Whether a box, freight, or passenger car serves its time, there is little to be scrapped. The trucks and rods are taken out and the wooden portion is burned or used for some purpose, such as toolhouses along the line.

Car equipment is not always discarded because worn out, but it may be out of style, or of too small capacity. One of the results constantly sought by railroad management is the reduction of hauling expense per ton per mile, and no road at this time thinks of a box car of less capacity than 60,000 pounds, and 80,000 or 100,000 is preferred. Monster locomotives and long trains of mammoth cars carry an immensely larger quantity of freight over the road in less time than formerly.

At a recent inventory it was found that there were in the service of the railways in the United States 44,871 locomotives classified as follows: Passenger, 10,870; freight, 25,944; switching, 8,057. The total number of cars of all classes was 1,803,389, assigned as follows: To the passenger service, 48,140 cars; to the freight service, 1,693,782 cars, the remaining 61,467 cars being those employed directly by the railways in their own service. Cars used by the railways that were owned by private companies and firms are not included in this statement. The average number of locomotives per 1,000 miles of line was 219. The average number of cars per 1,000 miles of line was 9,540. The number of passenger miles per passenger locomotive was 2,078,786. The number of ton miles per freight locomotive was 7,007,942. The aggregate number of locomotives and cars in the service of the railways was 1,848,260. Of this number 1,402,250 were fitted with train brakes, and 1,786,558 were fitted with automatic couplers. Practically all locomotives and cars in passenger service had train brakes, and of the 10,870 locomotives in that service 10,210 were fitted with automatic couplers. With respect to freight

RAILWAY ROUND-HOUSES

equipment most of the freight locomotives had train brakes, and 98 per cent. of them automatic couplers.

Locomotive building in the United States has reached that stage in its development when merely increasing the weight and size of locomotives for the railways to meet increasing weights of trains and severity of service does not suffice. It appears evident that to increase capacity, improve economy, and at the same time reduce injury to track a new development is needed. Already in Europe limits of size and weight in locomotives have been reached, and to meet analogous conditions in those countries the four-cylinder balanced compound locomotive has been developed into remarkably successful practice, especially in the principles of the de Glehn compound. To advance American practice by adapting to our conditions these principles, which have brought such advantageous results to European railways, is the object of the American Locomotive Company in its Cole four-cylinder balanced compound locomotive. It employs the principle of subdivided power; two of the cylinders (the high pressure between the frames) drive the forward or crank axle, and the others (the low pressure, outside of the frames) drive the second driving axle. In order to secure a good length for connecting rods without lengthening the boiler, the high-pressure cylinders are located in advance of their usual position. Special stress is laid on perfect balancing and the elimination of the usual unbalanced vertical component of the counter balance stresses, as a means for increasing capacity, improving economy of operation, and maintenance and promoting good condition of the track.

The question of properly loading locomotives has long since passed the theoretical stage, and it is now imperative to provide some practical and accurate method for obtaining the most economical results from operation. The putting of 125 per cent. on one train and 75 per cent. on another is not economical or in line with good practice, even though the average is 100 per cent. This condition exists on a majority of roads that do not provide for equating the tonnage of cars of different gross weight, and when engines are not properly rated. Some roads, when rating locomotives, take a given tonnage, say 2,000 gross tons, if in 65 cars, and the engine used its maximum power to haul it within the time allowed, that then becomes its rating. Now, when that same locomotive has 2,000 gross tons in 30, 40, or 50 cars, it is permitted to move over the road light loaded from 10 per cent. to 35 per cent., and in most cases is a net loss to the road so operating. It is impossible to build up all trains of equal average weight of cars; it is also impracticable to at all times place the heavy loads next to the engine, hence proper allowance must be made for each weight of car and its location in the train. The use of block signals has made it even more imperative that locomotives be not overloaded, for the reason that overloaded trains invariably stall on heavy grades, which, in turn, blocks trains following it on the same grade where they should have the benefit of momentum to assist them, but when stopped they frequently are unable to again get their train in motion, resulting in being obliged to double the hill,

delaying themselves, and possibly trains of a superior class.

It is well understood that the punishment inflicted upon cars and lading by current conditions in handling heavy-capacity cars in long trains with modern locomotives is a source of heavy loss, both in actual expenditure of money to make repairs and pay damages and in time lost by cars out of service. The real cause of this trouble was not so clear, however, until a dynamometer car was provided, capable of measuring the shocks and strains incidental to handling modern traffic. The recent West Seneca tests are in themselves sufficient to show the magnitude of these strains and the total inadequacy of existing spring gear to protect them, while the great capacity of the Westinghouse friction gear and the peculiar nature of the resistance employed, which enables it to absorb and dissipate serious shocks, is well illustrated.

It will be conceded that, directly and indirectly, the most vulnerable feature in the brake equipment of to-day is the hose connection, due to the fact that while designed to be *uncoupled* as well as *coupled by hand*, it is the pernicious but inevitable practice to pull them apart, thus injuring and ultimately destroying the hose, not to mention damage done to piping and consequent loss by leakage. Reliable statistics show that the automatic air coupler reduces cost of air-brake hose maintenance more than 50 per cent., while the saving in time required in making up or shifting trains is very great. The beneficial effect of this saving in crowded yards can hardly be estimated. Another time-saving appliance which is rapidly coming into use is the automatic brake slack adjuster. The adjustment of piston travel by hand is at best a slow process, and the results are generally unsatisfactory from the standpoint of economy in the wear of brake shoes, while the inequality of piston travel resulting therefrom produces an unevenness of braking effect in handling trains that might well be avoided. The automatic adjuster is a cheap and efficient remedy for these troubles.

The use of electric locomotives is becoming more extensive. For many different varieties of service they present features of economy, convenience, and safety that are rapidly bringing them into general favor. For mine haulage, electricity is by far the most convenient, flexible, and economical form of motive power. For light service on short railroads, for suburban freight and passenger traffic, for yard and tunnel service, for industrial haulage, power-houses, lumber yards, and plantations, it possesses many important advantages over steam.

HUGH T. DOWNING,
Mechanical Engineer.

Railway Round-Houses. The development of the steam railroad engine-house or round-house, as it is more commonly called, is coincident with the development of the railroad. It was sufficient, in the earlier days, to provide a house more as a protection from the weather than as a shop fitted with studied appliances for quickly and economically making locomotive repairs and attending to the regular routine work. As the development of the railroad called for specialists in its various branches, the round-house demanded its share of careful engineering

RAILWAY ROUND-HOUSES

to obtain the desired result of having each installation and its accessories arranged to best suit the local conditions.

The general principles which govern the planning of a round-house lay-out are: proximity to the car-yards; unobstructed connecting tracks; independent incoming and outgoing tracks; facilities on either or both of these tracks for supplying the locomotive with coal, sand, and water; facilities on the incoming track for taking care of ashes and clinkers; storage-room for the maximum number of incoming engines; and cross-over or auxiliary tracks to allow flexibility in handling any one engine as received on the incoming track in preference to others or to minimize the chances of a blockade due to accidents.

Construction.—Most engine-houses are round, hence the commonly used term. Pivoted at the centre of the house and usually in an open pit is the turntable. In regions of heavy snowfall this pit is often covered. Radiating from this centre are the tracks which enter the stalls of the house and also the incoming and outgoing tracks. The inner and outer walls of the house are, in their relation to each other, concentric polygons, with their diameters coincident. The diameter of the house is large or small according to the number of stalls that are desired in the completed circle, the inner circle being proportioned so that the door openings will be wide enough to amply clear the widest locomotive. General practice is to make these doorways 12 feet wide and at least 16 feet high in the clear opening. The distance from the inner wall to the outer wall for new houses is seldom made less than 80 feet and in many cases much more. Figuring for the longest locomotive to be handled, a sufficient space is left between the walls of the building and the ends of the locomotive to pass around the house and do the necessary trucking.

There are several prominent instances where rectangular and other special shaped engine-houses have been constructed. This plan is adopted either as an expedient to use to the best advantage all of a valuable piece of property or to have the building fit harmoniously into the general arrangement of other shops around it. Instead of being served by a turntable these houses make use of a transfer table or a set of fan-shaped tracks. For turning the locomotives a "Y" or a turntable is added.

In arranging the stalls of a round-house, care is taken to have opposite tracks match across the table. This little detail is of the greatest benefit in the operation of the house because it permits the handling of a dead locomotive by other locomotives under steam. If the tracks do not match, this cannot be done and much time is lost in moving the engine by hand.

Some sort of power device is generally used for turning the table. Electricity, compressed air, steam, and gasoline are employed according to the local conditions. When electric current can be depended upon at all hours of the day and night it is usually selected. Gasoline engines are preferable when an independent equipment is necessary. Compressed air and steam can be used to advantage but they are not as satisfactory.

Situated between the rails of the tracks in the house are the pits. These pits are for use

in getting at all parts of the running gear of the locomotive. They are made long enough to extend beyond the front wheels of the engine and the rear wheels of the tender. The usual length is from 50 to 60 feet, with the bottom sloping toward one end, in either direction, as best suits the drainage problem. The depth varies considerably, a fair average, however, is 30 inches at the shallow end and 36 inches at the deeper end. The pit floor is crowned in the centre, thus leaving a place as dry as possible for the men to stand on while under the locomotive.

A very important detail, from the operating standpoint, is the flooring of the house. This must be very substantial as well as impervious to water and oil, both of which are always present in large quantities. Experiments are being extensively carried on to determine what is the best floor to use, from which it appears that some form of concrete is the most satisfactory. Brick and cedar blocks as well as planking are also used extensively. The floor is arranged to shed the water as quickly as possible into the pits.

The heaviest service on the floor comes just outside the pits where lifting and jacking is done around the locomotive. With a view to strengthening this floor the sidewalks of the pits are sometimes made very wide so that the jacking can be done directly over them. Good heavy timber construction for this part of the floor is very serviceable.

Pipe outlets are arranged around the house so as to deliver compressed air, steam, and water to the spaces between the pits. The air and steam mains are ordinarily placed overhead with drop pipes for the outlets. At times, however, these mains are located in the same underground pit which contains the water mains. The pressure in the water main is maintained at least at 100 pounds per square inch. This pressure is utilized in washing out or cleaning the locomotive boilers of the mud and scale present, at times in large quantities.

Some sort of blow-off piping is ordinarily installed. The simplest plan is a main pipe connecting all the pits, from which there is a branch to each pit with a check and special fitting for connecting it to the boiler of the locomotives. The main pipe has an outlet through suitable catch basins and traps to the sewer.

In connection with the washing out of boilers, there are many more or less elaborate arrangements of pipes and reservoirs used, which have for their aim the saving of water and the conservation of the heat ordinarily wasted in the blow-off water.

The heating, lighting, and ventilating of engine-houses are problems which until recently have been only partially solved. Newer houses are constructed with the walls made, as far as practicable, of glass. The doors and even the roofs are also arranged to admit light. For night use, electric lighting is used, where possible. With a generous supply of plug outlets and extension lights, a model condition is obtained. The unsatisfactory oil torch and lantern are thus eliminated.

The heating and ventilating problems are being very successfully solved by the "hot blast" method of heating. This is the well known system of forcing heated air through ducts which

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distribute it advantageously throughout the building. For round-house use the particular advantages are in being able to concentrate a larger or smaller amount of hot air, as desired, upon the icy or frozen machinery of a locomotive and in supplying a large quantity of fresh air, continuously forcing out the gaseous and vitiated air produced by the fires in the locomotive boilers.

Machine Tool Equipment.—Very few round-houses of any importance are in operation which do not have some sort of machine tool equipment. The list contains, generally, a large and a small lathe, a planer, a shaper, a drill press, a bolt cutter, and an emery wheel. In case the house is not in touch with some repair shop, additional machines are installed, such as an air compressor, a dynamo, a wheel press, a wheel lathe, and drop pits. These, together with an assortment of air tools and the many special handy tools, permit of the heaviest running repair work being done on the locomotives.

Outside Facilities.—The outside facilities in connection with the round-house consist of the coaling station, the sanding appliances, the clinker pit, and the watering arrangements. These are ordinarily located on the incoming track between the storage track and the turntable. Their arrangement is varied to suit local conditions but, as far as possible, the clinker pit is placed close to the turntable. After the fire is removed from the grates it is very injurious to the boiler to handle the locomotive more than absolutely necessary, hence the clinker pit is located with this in view. The pit is some form of opening under the rails of the track into which the clinkers and ashes can be dropped. From the pit they are removed to the cinder cars for disposition along the company's right of way. A small pit is sometimes provided under the outgoing track for the cleaning of the ash pans of locomotives that are leaving the house.

Water is obtained directly from a tank by means of a drop spout or from a swinging stand pipe. Where conditions permit, this tank or pipe is located in connection with the sanding apparatus so that the locomotives can be supplied with one movement. The sand is supplied by gravity through a suitable pipe from an elevated storage bin. Before being stored it is dried or roasted so as to remove all traces of moisture.

The coaling station consists of some sort of elevated bin and a suitable spout to deliver the coal to the locomotive tender. Various types of coal chutes, as they are called, are used. A familiar form is the inclined track chute up which the loaded cars are pushed by a locomotive or hauled by a cable. The top of the chute where the cars are to stand is made level. The coal is removed into storage pockets. According to the type of chute, these are made large enough to hold several hundred tons of coal or small enough to hold a supply of coal sufficient for one locomotive.

In some installations, a combined coal chute, clinker pit, and sand tower is used. For this plan, a conveyor takes the coal from a pit under the coal supply track and deposits it in a hopper over the engine track. This hopper is supported on scales and autographic records are made of the coal delivered to the locomotives. This same conveyor also takes the ashes from the clinker pit to a storage bin from which they

are delivered to cars. The sand also is elevated to its special bin. With suitably located water supply this sort of installation is very economical of space. It also permits of the giving of all supplies as well as cleaning the fire with one "spotting" of the locomotive.

To take the place of a coal chute and a depressed cinder car track, locomotive cranes are often employed which are arranged with grab buckets. These cranes can take coal directly from the car and deposit it into the locomotive tender as well as pick up the ashes from the clinker pit and deposit them in the cinder car.

Organization.—A round-house is a scene of activity for all of the 24 hours of the day. The continued arrival and departure of locomotives, together with the routine work of repair and attention given them, requires an organization which must run with clock-like precision and at the same time must be capable of adjustment to abnormal conditions.

At the head of this organization is the round-house foreman, who is responsible to the division master mechanic. He also works in conjunction with the train dispatcher, having in view the getting of certain locomotives ready for service at the proper time for regular trains and others as soon as possible for extra trains. His particular duties are to distribute the work to the workmen and keep in touch with all that is going on in his domain. When the house is large and the amount of detail too great for the personal attention of one man, sub-foremen are appointed to have charge of such special work as machine repairs, boiler washing and inspection, engine dispatching, etc. These men take complete charge of the details assigned them and report to the house foreman.

The engine-men, on bringing the locomotive from the yards or station, leave it on the storage portion of the incoming track. The engineer looks over the entire machine, inspecting each part for defects and then makes a written report on a prepared form of what he finds wrong. He adds information concerning the boiler pops or safety valves, the injectors, the air pump, and other such special fittings.

The fireman attends to obtaining the necessary supplies, such as oil, waste, etc. It is customary in most instances for the engineer to leave a ticket for the amount of coal the hostler is to take on the tank. After leaving the locomotive the engineer registers in; that is, he fills out the register. Here he writes his own name, his fireman's name, his engine number, the train number, the time of arrival at the round-house, and all such train-operating information. Often he is required to show the hours that he has been on duty and the amount of rest that he is entitled to before he can be called for service.

The locomotive is taken from the storage track by the hostler and his helper to the coal chute, the sand tower, the water tank, and the cinder pit. The supplies are obtained and the fire cleaned before taking it across the turntable to the house. After reaching the stall, a second inspection of the machinery is made by a man trained to that special work. This man also makes a written report and the two records thus obtained must tally in important details. These work reports are used by the foreman or his assistant in distributing the work among the mechanics.

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A boiler maker enters the fire box and inspects and makes running repairs to the boiler, especially stopping all leaks as they are found in the flues and fire box. The smoke box at the front of the boiler is regularly opened and examined for defects in the spark-preventing devices.

At certain times, the periods varying according to the local water conditions, the locomotive boiler has to be washed out or have the water changed. If the latter course is pursued, the water is allowed to run out and the boiler filled with a fresh supply. If washing is done, the various washout plugs are removed and all the internal parts of the boiler thoroughly washed off. This is accomplished by the use of special nozzles of various sorts which will throw the high-pressure washout water to just the points desired.

Each mechanic, as his part of the work is finished, makes his "completed" mark on the engine condition board or on the locomotive itself. By reference to the board the foreman and the call boy can tell at a glance what locomotives are ready for service and approximately how soon others will be ready. As soon as definite information can be given as to the time that a "rounds" locomotive will be ready, the train dispatcher is notified. On his order, the engine-men are called and the locomotive sent to the yards.

Engine-men regularly assigned to certain trains are expected to be on hand in time to look over the locomotive, inspect all parts, see that all the necessary supplies are on hand, and take the locomotive either from the round-house stall or the outgoing track. If the train is unusually late the call boy is sent to advise them of the fact. The calling district is ordinarily within a radius of one mile of the house. Men on "rounds" engines or extra men, as they are designated, are always called. They are supposed to remain within the calling district and to advise the round-house foreman of their whereabouts. When called, the men are usually required to put their signature in the call book which the boy carries with him, and occasionally to add the time. Some organizations require a registering out as well as the registering in.

W. E. DUNHAM,
Mechanical Engineer, Chicago & North Western Railway Co.

Railway Securities. The capital required for even a relatively small railway is usually far beyond the amount which could be supplied by even the wealthiest individual or the largest group of individuals which could be satisfactorily included in a partnership. The legal device of incorporation is probably the only means so adapted to the requirements of railway finance as to provide the sort of capitalistic association necessary to the enormous railway development of the last 70 years. It meets not only the need for vast aggregates of capital, but also those for limited liability, centralized control and substantial continuity of management and policy. Consequently those who undertake railway enterprises invariably receive corporate securities in exchange for their contributions of capital and these, representing claims upon the property created and its earnings, are properly regarded as constituting liabilities of the cor-

poration. In the simplest form of financing a corporate enterprise the securities issued are all of one grade and participate equally in the distribution of the profits while having no other claim upon the assets of the corporation unless it is dissolved and its affairs wound up. Such securities are known as stock or shares of stock. In practice it has been found advisable to hold out different inducements to different classes of investors. Some investors are attracted by speculative proposals in which the possible gains are high, but the event doubtful, while others prefer lower returns if they are accompanied by greater certainty. The more conservative investors are therefore offered, according to their respective degrees of conservatism, preferred stock, non-cumulative or cumulative; income bonds; collateral trust bonds, equipment trust bonds, and mortgage bonds. Preferred stock is entitled to dividends at a certain rate before there is any payment to the holders of common stock and if it is cumulative the dividends not earned or paid during a particular year must be made up before there can be any dividend payments on the common stock. Preferred stock may or may not participate in further earnings beyond the rate for which it is preferred. Income bonds entitle the holder to a certain interest, provided it is earned. Collateral trust bonds usually rest upon the credit of the company issuing them and also represent pledged securities, commonly those of subsidiary corporations. Equipment bonds are issued to provide for the purchase price of new equipment, commonly paid for in annual or semi-annual instalments, and are secured by a lien upon such equipment. Mortgage bonds, as their name implies, represent indebtedness secured by mortgage upon all or part of the property of the corporation. Many railways have outstanding several classes of mortgage bonds of different degrees of priority. The following statement shows the par value of the securities of the different classes outstanding on 30 June 1902 and the proportion of each class to the aggregate representing all securities:

	Par value	Percentage of total
Common stock.....	\$4,722,056,120	38.92
Preferred stock.....	1,302,145,175	10.73
Miscellaneous obligations.....	564,704,588	4.65
Income bonds.....	242,556,745	2.00
Equipment bonds.....	89,208,425	.73
Mortgage bonds.....	5,213,421,911	42.97
Total	\$12,134,182,964	100.00

It is important that the total par value of the securities shown above should not be mistaken for the actual capitalization of railway property. It is considerably in excess of the real capitalization, that is, the securities in the hands of the real owners (and creditors) of the railways, for railway corporations are themselves large owners of railway securities. The controlling corporations in large systems often own large blocks of the stocks and bonds of subsidiary corporations for which, in turn, they have issued their own shares or bonds. Consequently there is much duplication which must be deducted before the real capitalization, so far as the public is concerned, can be discovered. The railway shares held by railway corporations on 30 June 1902 had a par value of \$1,710,145,344 and the bonds so owned had a par value of \$498,373,449.

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Deducting the total of these amounts, \$2,208,518,793, from \$12,134,182,964, leaves \$9,925,664,171, as the par value of the railway securities actually outstanding as against the railway system as a whole. It is interesting to observe that the total payment to the owners of these securities during the year which ended with 30 June 1902, was \$417,511,227, an amount which if capitalized at 4 per cent per annum would equal \$10,437,780,675 or within 5.15 per cent of the actual capitalization.

H. T. NEWCOMB,
Author of 'Railway Economics.'

Railway Shop Practice. Railway shop practice differs in many respects from methods in effect in the average manufacturing concern. This is especially true of the class and character of the work performed. In private institutions where the product consists largely if not entirely of new work, a single operation may be repeated over and over again. A factory making a specialty of the manufacture of bolts may construct a machine and supply it with a full equipment of dies to produce a certain size of bolt. The machine can then be operated up to its maximum capacity on this single product until it is worn to a point where it is rendered unfit for further service.

A locomotive plant, manufacturing new engines only, may so classify the work as to be able in almost every instance to confine the entire time of each machine to repeating a certain operation.

In the locomotive repair shop, however, on account of the wide range in the number of pieces and the small capacity of the average shop, such a variety of operations is required as to render necessary the accomplishment of many kinds of work on a single machine.

A 90-inch boring mill must be used to bore driving wheel tires, turn, bore and face cast iron and cast steel wheel centres, face locomotive front ends, turn and bore cylinder bushings, and so on. In like manner, a 42-inch boring mill will be required to bore eccentric straps, turn and bore eccentrics, face cylinder heads, turn, bore, and cut off cylinder and piston valve packing, and many other operations which in each case require special tools for setting and machining the work. One bolt machine will likely be used to head, and one thread cutting machine to thread all the different sizes of bolts for the plant.

Therefore, on account of the variety of the work to be considered, the scope of this article will cover certain rules, which, if carefully followed, should secure the maximum output of such average shop facilities as are to be found at present in connection with the various roads of the country.

The capacity of any shop depends as much or more on its official organization as upon the number of men employed. The discipline maintained in the shop during working hours and the relation of the foremen one to another are among the first subjects that will confront the shop superintendent, and which must be studied and mastered by him before he can hope to obtain results from the equipment and force in his charge.

Every railway repair shop is divided into certain departments, among which may be enumerated the erecting shop, or floor side; the

machine side, including the fitting shop, or vise work, and the tool room; the tin, pipe, and copper department; the blacksmith shop, boiler shop, paint shop, tank and truck shop, and carpenter shop. Under certain conditions there might be others, as the foundry, frog shop, etc., but this class of work will not be considered here. Each one of these departments should have an official head, and over all must rest the guiding hand of the master mechanic or shop superintendent.

A successful shop organization must be equal in all its parts, and the head of each department must be a manager of men as well as an observer of details. If the foreman in charge of a certain class of work is incompetent, inactive, or deficient in methods of discipline, or if he lacks a particular machine or device for quickly handling his part of the repairs, the output of the plant, no matter how well equipped every other department may be, will finally be measured by the number of engines which he is able to repair in a given time.

When capable men have been placed at the head of each department, the shop superintendent should then sustain them to the extent of his ability, holding them individually responsible for their duty to the company and their relation to the men.

The qualifications necessary to make up a well-rounded foreman are good health, judgment or common sense, honesty, determination, tact, energy, special knowledge of the work, and a fair education; and with his agencies, men and machines, he should work for results. He must plan his work ahead and see that each machine over which he has charge is supplied with the proper clamps, jigs, and appliances for doing the work, as well as proper cutting tools, and are used to set the work in the machine and cut the metal at the right speed and feed. This requires ability to take pains with little things and concentrate the necessary forces on a multitude of small things. Each machine must be kept clean and in good order, and to do this the foreman must be clean and neat himself.

The successful gang foreman must have executive ability which is nothing more or less than knowing how to distribute responsibility so that every workman not only accepts his share of duty, but continues unfailingly to do it. If he accomplishes results, he must know how to make other people feel the trust imposed upon them, and to faithfully perform the part of work assigned to their charge. Every man in the shop must be held responsible for his work, which should be the required amount and of the proper quality, not because the foreman watches him closely, but rather from a pressure of a right conception of his duty to the company which should make itself felt throughout the entire shop.

Gang foremen, so far as it is possible, should be relieved practically of all clerical work. Their time should be spent with the men in teaching them quick methods and looking after such details as have a direct bearing on the output.

A constant supervision should be kept over the work of each department to see that it is quickly moved from one shop to another, or from one machine to another, and to see that each operation is being done according to the best known methods or on the machine best adapted to that particular work.

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The sole object to be sought, both by men and foremen, must be the greatest possible output of perfect finished work with the least delay and waste.

To accomplish this, the particular line of work in charge of each foreman must be systematized. There must be a certain routine way of doing things, and that the best way.

This one thing should be remembered, however, that system is not work, but a means of reducing the amount of labor necessary to produce a fixed product; system requires no specialists, but permits few to accomplish much by bringing brain and hand into intelligent action. It loads no man with labor beyond his proper share, but lightens the task of each by exactly defining it. The heavy load usually borne by a few faithful employees is distributed evenly upon all. Hard work always begins where system and the application of intelligent methods ends.

The Machine Shop.—The capacity of any locomotive repair shop depends largely, if not entirely, on the number and kind of its machines, but the introduction of the so-called high speed steels has had much to do lately with increasing the output of this department. The new steels have worked a revolution among machine builders generally; the old time lathes, boring mills, drill presses, planers, etc., are found to be entirely too weak to stand the great strain necessary to drive the new steel to its maximum capacity. The history of this comparatively new product had its origin in the introduction of the Taylor-White process of treating tool steel in the works of the Bethlehem Steel Company, in 1900. Hundreds of experiments were made by these two gentlemen, which finally resulted in producing a steel which is capable of producing in a given time two or three times as much work as any of the old carbon steels.

Another very gratifying result of these experiments is that they have awakened the management of railway repair shops, and the amount of work that can be done, even on the old machines, is a revelation to the entire mechanical world.

There are several brands of this steel, those in general use being Mushet's Special, and Allen high speed steel, which is an English product; Styrian or Bohler rapid steel, an Austrian product; Midvale, Novo, Rex, Zenith, etc. While some of these steels may be capable of greater endurance than others, any of them, under proper treatment, will be found superior in strength to any of the machines now in use, except those recently built. In using the high speed steel, however, it is not advisable to have too many different kinds in the same plant.

If the tool dresser is thoroughly familiar with one or two grades of high speed steel, and the quality is of such character as to produce results which will insure the maximum capacity of the machine, better results will be obtained by the adoption of these grades to be used in standard practice. No two high speed steels can be dressed and tempered exactly alike if the maximum output is desired, and if the tool dresser understands treating one of the standard grades correctly, the adoption of this make of steel will mean much time and money saved with better and more satisfactory results in the shop.

When these high speed tools are properly dressed and tempered, if it happens that the cutting edge is work, chipped, or crumbled away by very heavy feeds or speeds, after they are put into the machine the mistake of sending them back to the tool dresser should not be made if they can possibly be ground in the space of five or ten minutes, because if care is taken not to overheat them in grinding, they will be found to give much better results than when re-ground.

Some differences of opinion have existed, and perhaps always will, as to the proper feeds and speeds which should be maintained on the different metals, and no fixed rule can be laid down which will meet the requirements of all shops. The work varies somewhat in different shops. There is more or less difference in the construction of the parts.

The amount of metal to be removed and the accuracy of the work are also factors in determining proper feeds and speeds; but the fol-

A. B. C. RAILROAD COMPANY

Shop _____ Date _____

Description of Operation and Material: _____

Boring 60-inch driving wheel tires.

Machine: _____ 60-inch boring mill.

Tire No.	Size of Tool.	Depth of cut.	Feed.	Speed per min.	Time started.	Time finished.	Duration of tool.	Remarks.
1	1-1/4 by	1/10"	5/32"	30'-8"	3.37 P	4.01 P	24 M	Tool in good condition.
2	1-1/4	3/32"	"	"	4.39 P	5.04 P	25 M	" "
3	"	"	"	"	7.03 A	7.28 A	25 M	" "
4	"	1/10"	"	"	8.12 A	8.38 A	26 M	Tool in fair condition.
5	"	"	"	"	10.12 A	10.30 A	27 M	" "
6	"	3/32"	"	"	11.12 A	11.38 A	26 M	Nose of tool gone.
7	"	1/16"	1/4"	34'-0"	8.57 A	9.08 A	11 M	Tool in good condition.
8	"	"	"	"	9.40 A	9.51 A	11 M	" "
9	"	"	"	"	10.25 A	10.37 A	12 M	" "
10	"	"	"	"	11.00 A	11.13 A	13 M	Tool in fair condition.
11	"	"	"	"	11.40 A	11.50 A	10 M	" "
12	"	"	"	"	1.20 P	1.35 P	15 M	" "
13	"	"	"	"	3.05 P	3.20 P	15 M	Tool ground.
14	"	1/8"	"	23'-0"	8.44 A	8.58 A	14 M	Tool in good condition.
15	"	"	"	"	9.30 A	9.51 A	14 M	" "
16	"	"	"	"	10.23 A	10.38 A	15 M	" "

RAILWAY SHOP PRACTICE

lowing table taken from the records of an average railway repair shop shows what should be done in the way of speeds and feeds on a machine of ordinary capacity. An average grade of high speed steel was used, and the condition of the tools shown at the end of each operation, is a fair representation of what should be accomplished in any shop with like tools and under similar conditions.

The preceding table shows the machine operation only. The time necessary to set the work will, of course, be determined largely by the facilities at hand for that purpose. With the exception of driving and truck wheel tires, cast steel wheel centres, and similar material, the following speeds can be maintained in roughing out work. A somewhat higher rate of speed may be used on finish cuts: Wrought iron and soft steel, 40 to 60 feet; cast iron, 60 to 80 feet; tool steel, 20 to 40 feet; brass, 120 to 180 feet.

These speeds, of course, may be affected both by the shape of the tool and the quality of the material. For long, continuous cuts on very hard cast iron, the speed should be reduced. Locomotive steel driving axles, rough forged, should be reduced to size ready for finish cut at a speed of 60 feet per minute, with $\frac{3}{16}$ -inch cut and $\frac{1}{4}$ -inch feed. Locomotive driving wheels, 44 inches to 84 inches in diameter, may be turned at a speed of 15 to 18 feet per minute, with $\frac{1}{2}$ to $\frac{3}{16}$ -inch reduction and $\frac{1}{8}$ to $\frac{3}{16}$ -inch feed. On the modern 50 horse-power 90-inch lathe these wheels should be turned out at the rate of five pairs in ten hours. A cylinder packing drum 18 to 24 inches in diameter and of sufficient length to make at least 12 rings should be set up and roughed out on a modern boring mill in about one hour. The finish cut should be taken with a broad-nose tool in about five minutes, including time to change tool. Piston rods, rough forged, should be roughed at a speed of from 60 to 80 feet per minute with $\frac{3}{16}$ -inch feed and $\frac{1}{8}$ -inch to $\frac{1}{4}$ -inch depth of cut. Cast steel engine frames should be planed at a speed of 20 to 30 feet per minute with a $\frac{1}{4}$ -inch cut, $\frac{1}{2}$ -inch feed.

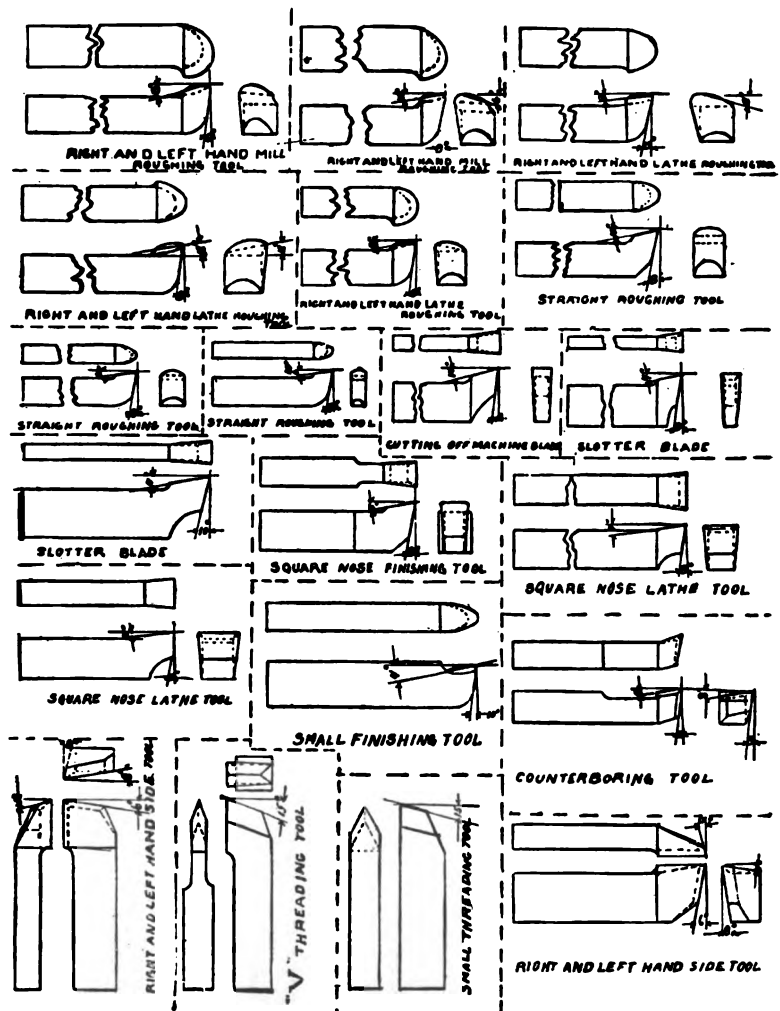
These speeds and feeds can only be maintained on modern tools. On machines which have been in use for some time the speed and feed should be reduced to meet the conditions.

Planers.—Planers using high speed tools should maintain the following cutting speeds with a return per minute of about two to one.

20 x 20,	speed travel of cut	40 to 48 ft. per min.
24 x 24,	" " " "	36 to 40 " "
36 x 36,	" " " "	32 to 36 " "
48 x 48,	" " " "	28 to 32 " "

If planers are powerful enough to pull the cut, the above speeds should work on wrought iron and soft steel as well as cast iron.

Lathe and Similar Cutting Tools.—The following sketches show what, in general practice, have been found to be the best shapes of cutting tools used in the principal operations of repair work:



The cutting qualities of a tool are governed largely by the shape of the cutting point or cutting edge. The principal conditions governing the shape of the tool are the kind of metal

RAILWAY SHOP PRACTICE

to be cut; the hardness of the metal; rough or finish cut; and manner in which tool is presented to the work.

For soft material, such as mild steel and wrought iron, the angles may be made much keener than when cutting harder metals. On materials that have a tendency to draw the tool in, as copper or brass, the angles may be made very blunt, often a negative take is given them. Tools for cutting soft iron and steel should be ground with sufficient keenness to turn long, curled shavings. The shaving is a good index with reference to the correct shape of the tool. When the shavings roll up in long curls, it is a very good indication that the tool is correctly ground and properly set in the tool post for the work; but if the shavings are crumbled and broken into small pieces, it indicates that the tool is improperly ground, or not correctly set to the work.

Either one or both conditions may be wrong. Tools used in taking heavy-roughing cuts should be given top rake sufficient to give a keen cutting edge the full depth of the cut taken.

In finishing cuts the amount of metal is not great, and most of the cutting is done with the point of the tool, in which case the top rake should be reduced. The position of the tool in the post will have much to do with the rake. For instance, the angle of top rake may be changed from front top rake to side top rake by changing the position of the tool as it is presented to the work.

If the tool is set with the point in advance of the tool post, care must be taken to see that it is firmly held, because if it becomes loose, it will "dig in" and is likely to spoil the work. If the tool post is set in advance of the point of the tool, there is little danger of serious results, should the tool become loose, as it will swing away from the work.

Tools for cutting iron and steel should be set as high as possible on the work, and always above the centre, while for brass it is best to grind the tool without any top rake and set it on the centre or slightly below the centre.

Cutting tools for machine operations, whether turning or boring, should be ground so that their rake or top angle will be sharp to the heaviest part of the chip. For instance, if a tool is to be used for facing the hub of a wheel, the part of the tool which first comes in contact with the iron should be a sharp angle, so that the heaviest part of the chip will flow easily away, while that part of the tool that leaves its mark on the finished face will take a shearing cut or angular shaping cut, and leave a smooth surface.

There is no more important point to be borne in mind by any one wishing to know how to obtain the best work from a machine than the cutting angles of the tools. In a general way every one knows that a tool should have as little clearance and as much top rake as consistent with the wear of the tool, but the man that makes the greatest record is the one that puts it into practice.

The next point is that no tool should be allowed to project beyond the holder or support more than is absolutely necessary. After the tools have been ground and set properly, they should have a chip or feed course enough to keep them from losing the edge in the vain employment of making thin chips—for if the chips are very fine it means that the tool has not only removed the metal but cut it into fine chips of no special value. Weak lathes generally do better work with a medium feed than a fine feed. A very fine feed is often used in trying to turn an extra true piece of work, with the result that the tool does not leave an even surface. It alternately "digs in" and "backs out" with a fine feed, when a medium feed would have resulted in an even steady cut.

Chattering frequently occurs because the chip or cut is not large enough to hold all the slack of the springing parts. More feed is usually the cure for chattering. Of course, chattering may be caused by a cut that is just heavy enough to balance the weight of the work and spindle, and then the slight necessary looseness of spindle bearings gives the chance for chattering. An old-fashioned remedy for this is to turn the tool upside down to get the pressure down on the work.

Chattering is destructive to the sharp edge of the tool and should be stopped as soon as noticed; but do not think a lighter cut is necessary, for frequently a heavier cut stops the chattering.

Facing cuts should be taken by tools with round shanks, for these can be turned so as to give the desired rake for free cutting.

In facing a piece in which the diameter of the cut in one place is two or three times its smallest diameter, make sure to take advantage of the change in speeds, for a very important reduction in time of operation as well as the durability of the tool may be effected by these changes.

Twist Drills.—The following table shows the revolutions per minute, and also the feed per revolution at which high speed twist drills can be run with safety. The revolutions mentioned are intended for wrought iron and steel and also for cast iron. On cast iron, however, it

HIGH SPEED DRILLS			CARBON DRILLS		
Size of drill	R. P. M.	Speed Per Rev.	Size of drill	R. P. M.	Speed Per Rev.
1/4 inch	1050	.008	1/4 inch	450	.005
3/8 "	700	.011	3/8 "	300	.005
1/2 "	500	.016	1/2 "	210	.007
5/8 "	420	.016	5/8 "	160	.007
3/4 "	350	.016	3/4 "	140	.010
7/8 "	300	.016	7/8 "	130	.010
1 "	260	.020	1 "	110	.010
1-1/8 "	230	.020	1-1/8 "	100	.010
1-1/4 "	210	.020	1-1/4 "	90	.015
1-1/2 "	180	.020	1-1/2 "	75	.015

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will usually be possible, unless the metal is very hard, to exceed these speeds 20 to 25 per cent; and on brass the speeds may in most cases be doubled without injury to the drill. On the right will also be found a table of the speeds and feeds of carbon drills.

Carbon drills should seldom exceed 28 to 35 feet per minute on iron and steel and 60 feet on brass, measured on the circumference of the drill, and a feed per revolution of .004 to .007 for drill 3/8" and under in diameter. At these speeds and feeds it will be necessary to use plenty of oil or a solution of drilling compound when drilling steel, wrought, or malleable iron. It will also be found advisable to vary the speed somewhat according as the material to be drilled is more or less refractory.

High-speed drills may be run at a safe speed of 60 to 80 feet per minute on steel and iron, while no oil or drilling solution is required.

It has usually been considered good practice to grind the cutting edge of twist drills at an angle of 59 degrees, but recent experiments made with high-speed steel prove conclusively that an angle of 45 degrees will give equally good results with much less thrust on the drill. The following table shows the results of experiments along this line:

Angle of drill.....	37°..	45°..	50°..	55°..	59°..	65°
Thrust in pounds....	215	..225	..240	..260	..290	..325

These tests show that the thrust would be decreased by having more of a point on the drill. With an angle of 37 degrees, however, the drill would not stand up well on the work. At 45 degrees the drill stood up to the work as well as at 59 degrees and with much less thrust. The moment remains practically the same no matter what angle is used, so that the driving power does not change with the angle of the drill.

In order to obtain the best results from the use of high-speed twist drills it is necessary to observe carefully the following points:

1. Do not immediately run the drill at a very high rate of speed, but feed it slowly into the work at a good practical speed, allowing the drill to make one or two holes before driving it at its full capacity. This will prevent the sharp cutting edges of the drill from chipping out and also the point from breaking off. After the drill has become thoroughly warmed up to the work, the speed may be increased considerably without any danger of breaking the tool.

2. The drill should be run dry on cast iron and usually no lubricant will be required on iron and steel. If a lubricant is used at all it should be an ordinary soap and water compound or some of the compounds on the market for this purpose. Do not use plain water as a lubricant.

3. In grinding the drill do not press the point too forcibly against the stone as it may cause a number of surface cracks which in due time will cause the tool to break. On account of the very fine quality of the steel, much care should be exercised in grinding to insure maximum results from the drill.

Do not heat the drill to a high temperature in grinding as it will destroy the cutting quality of the steel.

4. The socket into which the drill fits should be in good condition and accurate in size so

that the drill will fit into it perfectly; otherwise the tang of the drill may twist off or the entire drill split to pieces through no fault of the steel.

5. On account of the high speed and feed at which these drills are operated it is necessary that the work be securely fastened, any slight movement of the work may destroy the drill. The work should never be held by hand.

Grinding Tools.—Lathe, planer, boring mill, and all similar tools should be carefully ground on machines built specially for the purpose, and one man or one set of men should be in charge of this work. When a machine man wants his tool ground he should give it to the man in charge of grinding and get another the same size and of exact shape, a stock of tools being always kept ground and ready for use.

This method guarantees uniformity in the shape of the tool and will result in a maximum output of the machine in which it is used. If the shop is large enough to warrant it, boys should be employed to deliver tools to and from the grinding room.

Methods of Paying for Labor.—Straight shop time or the hourly rate is still the most common method used in locomotive repair shops to pay for the services of the workmen, and this method is so well understood by all shop managers that explanation is unnecessary.

The contract system is used to some extent in paying for certain classes of repairs among which may be mentioned forging iron by the ton from the scrap for locomotive frames, rocker arms, piston rods, driving axles, etc. This consists briefly in agreeing with the leader of a gang of men to pay a certain fixed price per ton for taking the scrap iron or steel and forging it into such shapes as may be most readily worked into frames, axles, or similar parts. The leader of the gang employs such help as he thinks advisable to use on the work and pays a certain price, previously agreed upon, for the services rendered. In large shops this method may also be employed in turning driving wheels, overhauling pistons and rods, removing, overhauling, and replacing steam and dry pipes, etc.

Another method of rewarding labor is what is known as the differential rate system of piece-work. This consists in offering two different rates for the same job. If the work is finished in the shortest possible time and in perfect condition, a high price per piece is paid. If the workman is longer in performing the operation than the time which the job should take, or if there are imperfections in the work, he is paid a low price for his labor. The chief merits claimed by this system are reduced cost of output and increase in wages.

Accurate knowledge in rate-fixing which prevents any desire on the part of the workmen to "soldier" or hold back on the work in an endeavor to deceive the management as to the exact time required to perform any fixed operation. More uniform and just treatment of the employees resulting in a corresponding increase in the quality and amount of work. The selection of the best men for each class of work and the sifting out of those who are incurably lazy or inferior. The promotion of a most friendly feeling between employee and employer. This system readily adopts itself to the manufacturing concern, but on account of the great variety and

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complex nature of locomotive repairs it is little used, if any, for railroad repair shops.

Straight Piece-Work.—Beyond straight shop time, the straight piece-work system most readily adapts itself to the railroad shop, and is fast

venient for use by the shop specialist in timing all machine operations. This card is equally applicable to operations in other departments, in which case, of course, the speeds and feeds are omitted.

A. B. C. RAILROAD COMPANY

Shop _____ Date _____
Description of Operation and Material _____

Machine_____		Time Started_____		Time Finished_____					
SPEED		FEED PER REV.		TIME—MINUTES		TIME—MINUTES		Time to Change and Grind Tools	Total Time Minutes
Rough Cut	Finish Cut	Rough Cut	Finish Cut	Rough Cut	Finish Cut	To Set	To Remove		

Name of Workman _____ Day Rate _____
Remarks: _____

Assistant to Gen'l Foreman.

becoming popular. It consists briefly in ascertaining the time necessary to perform each elementary operation and fixing a certain definite price to cover the same.

The duty of carefully timing each operation

As fast as information for different operations is collected on these cards they are turned in to the office of the shop superintendents and the following permanent record card is made out in duplicate:

SCHEDULE No. _____

A. B. C. RAILROAD COMPANY

RECORD OF OPERATIONS FOR ESTABLISHING PIECE WORK PRICES.

SHOP	DATE	CAR NUMBER	PATTERN NO. OR SHAPE NUMBER	CLASS ENGINE OR CAR
MACHINE	SHOP NO.	TOOL STEEL	MATERIAL	

DESCRIPTION OF OPERATION.

TIME SETTING		TIME MACHINING	TIME REMOVING	TOTAL TIME	ROUGHING CUTS			
					SPEED	FEED	DEPTH	NO.
FINISH CUT		NO. OF PIECES	OPERATIVE	RATE	COST PER PIECE	PRICE RECOMMENDED		
SPEED	FEED							

Piece Work Inspector
or Foreman. _____

General Foreman. _____

REMARKS: _____

APPROVED:

Master Mechanic. _____

Shop Specialist. _____

Mech. Supt. _____

and fixing a price which will allow the workman to earn a reasonable amount over his daily rate provided work is of the proper quality and completed in the required time, is usually put into the hands of a person termed the speed boss, assistant to the general foreman, shop specialist, etc.

The following card will be found very con-

After these cards have been approved by the mechanical officials in the order in which the titles appear, the original is filed in the office of the superintendent of motive power and the duplicate returned to the master mechanic or shop superintendent as authority to use the price.

When piece-work prices have been fixed for all operations in any department, they are made

RAILWAY SHOP TIMEKEEPING

up in detail according to the following illustration which is reproduced from a page of a piece-work schedule in effect on one of the leading railroads.

A. B. C. RAILROAD COMPANY MECHANICAL DEPARTMENT.

Pattern or shape number.	Schedule number.	Name of part and description of operation.	Price.
		ROCKER BOX	
		Halves planed to fit together as follows:—	
	B 304	Class G-1 to 4, each box,...	
	B 305	Class H-1 to 4, each box,...	
		Plane to fit frame, as follows:—	
	B 306	Class G-1 to 4, each box,...	
	B 307	Class H-1 to 4, each box,...	
	B 308	Old, re-planed for closing, each box,.....	
	B 309		
	B 310		
	B 311		
	B 312		
		SHOES AND WEDGES	
		Plane complete, except on back, for thickness, as follows:—	
	B 313	Class G-8-9, H-7, E-1, D-6-7-11, each,.....	
	B 314	All others, each,.....	
	B 315	Plane for thickness, all classes, each.....	
	B 316		
	B 317		
	B 318		
	B 319		
		STEAM CHEST AND COVERS	
	B 320	New, plane complete, D-1-2, each,.....	
	B 321	Old, re-plane, one side only, D-1-2, each,.....	
	B 322	Old, re-plane, both sides, D-1-2, each,.....	

These sheets are bound in book form and put into the hands of the gang foreman and piece-work inspectors for permanent use in the shop. A letter is placed before the number of each operation to distinguish one department from another in timekeeping and accounting.

W. S. COZAD,
Shop Specialist, Erie Railroad.

Railway Shop Timekeeping. The system of timekeeping herein described, if intelligently applied, will meet all requirements in every department of a railway shop, whether on a day-work or piece-work basis. It may be handled entirely with cards, with the single exception of the time book. The cards can be made from a cheap grade of manilla cardboard and will be very convenient to handle both in the shop and office.

Checking Employees to and from Work.— Assume, as an illustration, that the shop employs 1,000 men. These men would likely be distributed among the different departments about as follows:

Erecting shop	150 men
Machine and fitting department.....	250 men
Boiler shop	200 men
Blacksmith shop.....	150 men
Tin, pipe and copper department, paint shop, carpenter shop, laborers, etc.....	250 men

To maintain a proper check on 1,000 employees, it would be necessary to establish check rooms or booths at perhaps four different points in the shop so that they will be easily accessible to the men and to allow proper handling of the cards within the limited time allotted for this purpose.

In this booth may be located a case containing about 250 separate departments as shown:

1			
2			1-100
3			
4			
etc.			101-250

At each one of the points an opening may be made in the wall of the room similar to the window in a ticket office, and through this window the card shown in the illustration below should be delivered to and received from the men:

No. _____

A. B. C. RAILROAD CO.

Daily Time Record of _____ Shop _____ Date _____ 190 _____

CHARGE	PIECE WORK		DAY WORK		HOURS	DESCRIPTION OF DAY WORK
	COMMENCED	FINISHED	COMMENCED	FINISHED		

Correct: _____ Foreman.

RAILWAY SHOP TIMEKEEPING

One of these departments should be assigned to each employee and be so designated either by his name or number. In small shops where timekeeping is handled in the office of the general foreman, the departments on the right, numbered 1-100, 101-200, etc., can be used as a permanent file for piece-work cards.

At the end of each month, a sufficient number of cards (one for each day in the following month) should be stamped with the department, the employee's name, and placed in the proper "pigeon hole" in the case. This can be done with one blow of a rubber stamp with movable type, by having the block so constructed as to fit the blank spaces on the card. A bright, active boy can accomplish this work for 250 men in about two days.

The shop, office, or booth in which these cards are kept should be opened 15 minutes before the whistle blows and the person entrusted with this work must be on duty ready to give out the cards as the employees call their name or number — numbers are preferable because when a man leaves the service the person employed to fill his place can take the original number without any change whatever in the filing case. As each man passes the window arranged for this purpose and calls out his number, the card should be taken from his respective department in the case, the date and time of entering service stamped on it with a rubber stamp and passed out to him. At 12 noon the window is opened and the cards received from the men as they pass on their way out. During the noon hour the cards should be distributed in the case, and at 12.45 P. M. the window is opened again and each employee receives his card after the time at which he commences duty has again been stamped on it. This is his certificate to show that he was in the shop and ready for service at the time prescribed by the company. At 6 P. M. these cards should be collected at the window from which they were received by the workmen, approved by the foreman, and turned in to the office of the general timekeeper, where they should be properly entered in the daily time book.

At precisely 7 A. M. and 1 P. M. the windows should close, and any employee coming in after that hour may be required to apply at the office for the card, which should have marked on it in red ink the time at which he enters service. Any workman entering service without his "Daily Time Certificate" properly marked should be liable to lose the time for that half day, subject only to the discretion of the shop superintendent.

The card used to check employees in and out of shop will answer in every department of railway repairs, both cars and locomotives, in making daily record of all shop or day-work time.

The only difficulty to be guarded against in handling this work is in securing the proper charge. If the cards are allowed to pass unchecked by the gang foreman of the department, the men are liable to become indifferent and careless in fixing the exact number of hours against each engine or account where their work is of a miscellaneous nature. These cards should be carefully checked each day by the foreman in charge to obtain satisfactory results. In shops where a part of the time is on a piece-

work basis this should be recorded on the following card:

CARD No. _____

A. B. C. RAILROAD COMPANY

PIECE WORK CARD

Shop _____ 190__						
CHARGE TO	SCHEDULE	NO. PIECES	PRICE	COST	DISTRIBUTION	
					PR-RATED EARNINGS	
					DAY RATE	
					TOTAL HOURS	
					DATE AND HOURS LABOR PERFORMED.	
					DATE	HOURS
					NAMES OF WORKMEN.	
					NUMBER	

Piece Work Checker _____
Foreman _____

To handle this card successfully it is necessary to have piece-work inspectors to inspect the work and use this card in making a proper record of the time. The piece-work inspector or time inspector as they are called in some shops should personally see each man who is paid by the piece, at least once a day, inspect the quality and amount of work which he has done, and by use of the schedule referred to on a previous page, make a careful record of the number of pieces and the price per piece, extending it as indicated on the card.

This inspection should be repeated day after day until the piece-work record card is full of items when either the total amount can be carried to the top of another card and the operation continued or the card may be totaled.

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properly signed, and turned in to the general timekeeper for entry in the time book.

time book may be printed according to the following illustration:

A. B. C. RAILROAD COMPANY PIECE-WORK

Name _____					Name _____				
Occupation _____					Occupation _____				
Date	Card number	Hours	Rate	Amount	Date	Card number	Hours	Rate	Amount

SHOP TIME

Day Rate _____ Per Hour

Charge	Date												Day rate	Amount

The piece-work inspector should know his men and the position in which he will find them in going from one machine to another and from one gang to another in the shop and he should be provided with the necessary means in the foreman's office to arrange the cards accordingly.

When these cards are received in the office of the timekeeper they should be numbered consecutively from one up for each department, commencing with the first day and continuing through to the end of the month.

The above illustration shows a leaf of the time book for recording day-work and piece-work time.

Best results will be obtained by entering all shop time once each day, and in shops where charges to different accounts are numerous this book can be printed so as to use one page for piece-work and the opposite page for shop time; or, the book may be made large enough to provide ample room for both entries on same page.

In making out the monthly distribution of the various charges for work done in the different departments the form below will be found very convenient.

This sheet can be printed in a size to meet the requirements of the shop and a space left at the top of each column for the engine number or other charge. By the use of these sheets

DISTRIBUTION SHEET

Shop for _____

19____

Engines	Cars	Expenses	Shop Orders

This book should be printed in a size which will meet the requirements of the plant.

The time recorded on the piece-work card should be entered in the book according to the card number and to the man who performed the work. Where two or more men work together on an operation covered by a piece-work price, the number of hours worked and the amount earned by each should be entered in each case against the card number.

In recording the shop time where the cards are turned in each day, the distribution of the different charges should be made when the time is entered in the book and the cards filed in a case arranged in alphabetical order so that they will be readily accessible in case of error or dispute.

A combination piece-work and day-work

the charges on the piece-work cards can be transferred as often as they are sent in from the shop, thereby distributing more evenly the office work through the month. **WM. S. COZAD,**

Shop Specialist, Erie Railroad.

Railway Signals. The subject of railroad signaling (with fixed signals) falls under three heads: the block system, concentration of switch and signal levers, and interlocking. The second and third may be considered as one. Block signals are used to maintain an interval of *space* between trains following one another. The regulation of trains by the maintenance of an interval of *time*, at stations, is imperfect because, if, in the case of a curved line or when the engineman's view is obscured by fog or falling snow, the foremost of two trains is unexpectedly stopped and delayed between stations,

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a collision may ensue in consequence of the negligence of a flagman or an engineman, or failure of lights or torpedoes. The block system at first was maintained by the employment of signalmen at each station, who, by telegraphing one to another, regulated the movement of the trains. The high cost of this system, due to the necessity of employing an attendant night and day at every station, led to the invention of automatic signals, which render the signalmen unnecessary. The large item of wages being saved, the block sections can be made as short as may be desired, thus increasing the capacity of the railroad by enabling trains to follow one another more closely.

The levers working a group of switches are concentrated, primarily, to save the time and labor of the switch tender, who otherwise must be continually running from one switch to another; but the principle is applicable, of course, to any number of switches within workable distance, say 500 to 800 feet; and at a city passenger terminus one man is able to attend switches which otherwise might require a half dozen attendants. The levers working the signals are of course likewise concentrated, and all are supported in a frame together. Interlocking is necessary where levers are concentrated, because moving a number of levers in wrong sequence may lead to a collision of trains. At a crossing of one railroad with another, for example, the attendant might inadvertently give clear signals on both of the lines at the same time. By locking the levers, one against another, so that he cannot do this, such an error is made impossible. At a drawbridge the signals controlling the movements of trains are interlocked with the apparatus by which the draw is locked in position. At drawbridges, and also at most crossings, a diverging track or a derauling switch is provided, so as to divert a train in case its engineman disobeys the stop signal.

The Telegraph Block System.—In this system, communications are made, in England, with apparatus like the needle telegraph, and in America with the Morse telegraph. A short code of signals by electric bells answers all ordinary purposes, and this is used in many cases. The telephone is also used to a limited extent, and is used as a convenience where the bell-code is the main reliance. The diagram (Fig. 1) represents the block signals at a single station, which we will call station *B*. The east-bound track only is shown. The principal sig-

may put signal *b* in the all-clear position and permit the train to enter the section between *b* and *s*. If the last preceding train has reached station *C* and has been reported clear of the block section *B-C* signal *s* may also be cleared, indicating that the road is clear to *C*. When both *b* and *s* are cleared, the distant signal, *d*, may also be cleared, but not otherwise. The distant signal, when its arm is in a horizontal position, indicates that the train must stop at *b*, but when the arm is inclined downward it indicates that *b* and *s* are both clear. In case of fog or snow-storm, or if the engineman's view is obscure in consequence of a curve in the line, this distant signal obviates the slackening of speed which otherwise might be necessary to enable the engineman to make sure of a clear signal at the home signal *b* before passing it. The signals referred to are semaphores, one of which, with a wooden post, is shown in Fig. 2. On American signals the arm or blade always extends to the right; in England to the left. The upper arm gives the indications, as just described, for the main line. The lower arm is to give indications for diverging tracks (supposing there were such a track at *T*, Fig. 1). The casting at the left hand end of the blade is fitted with a red glass spectacle for giving the "stop" indication at night. When the arm is inclined downward, to indicate all-clear, the spectacle is lifted, disclosing the white (un-colored) light, the all-clear signal. Where green is used for the all-clear indication at night, a double spectacle, with both red and green glasses, is provided. The counterweight *c*, one for each arm, serves to return the arm to the horizontal or stop position in case of breakage of the wires. On some railroads the semaphore arm is made to take any one of three positions: horizontal for stop, vertical for all-clear and half-way between, meaning "caution." On certain other roads the arm is inclined 45° upward from the horizontal to indicate caution. Where signals are required for two parallel tracks they may be set on a "bracket-post" as shown at *A* (Fig. 2). At *B* (Fig. 2) are shown home signals for movements in the same direction on two parallel lines, and distant signals for the same lines, the distant signals regulating the approach to home signals farther on. For low-speed movements, as from a siding to a main track, a dwarf signal is used (*C*, Fig. 2). Where signals are required for more than two tracks side by side they are usually set on a bridge spanning the tracks above the tops of the cars.

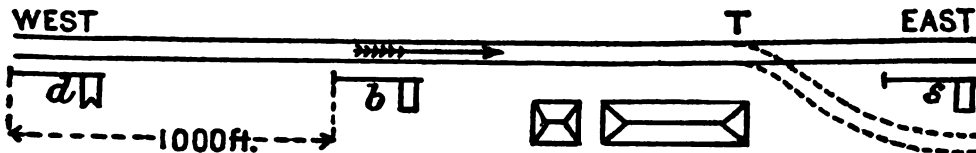


FIG. 1.—Signals at Block Signal Station.

nal, called the home signal, is shown at *b*. When a train is ready to proceed from *A* to *B* the attendant at *B*, receiving notice from *A*, replies, saying whether or not the line from *A* is clear as far as signal *b*; in other words, whether or not the last preceding train has passed wholly beyond *b*. If the line is clear, *A* then permits the train to proceed. If the line from *b* to *s* (the starting signal) is clear, *B*

Signals are further explained below, under *Interlocking*.

To provide against errors of signalmen, W. R. Sykes and others have devised electric controlling apparatus, so that to admit a train to a block section it is necessary to have the concurrent consent of the signalman at both the entering and the outgoing ends. This arrangement is called "controlled manual" or "lock-

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and-block." It is used on the London, Brighton & South Coast Railway and others in England and on the New York Central & Hudson River, the New York, New Haven & Hartford, and others in America.

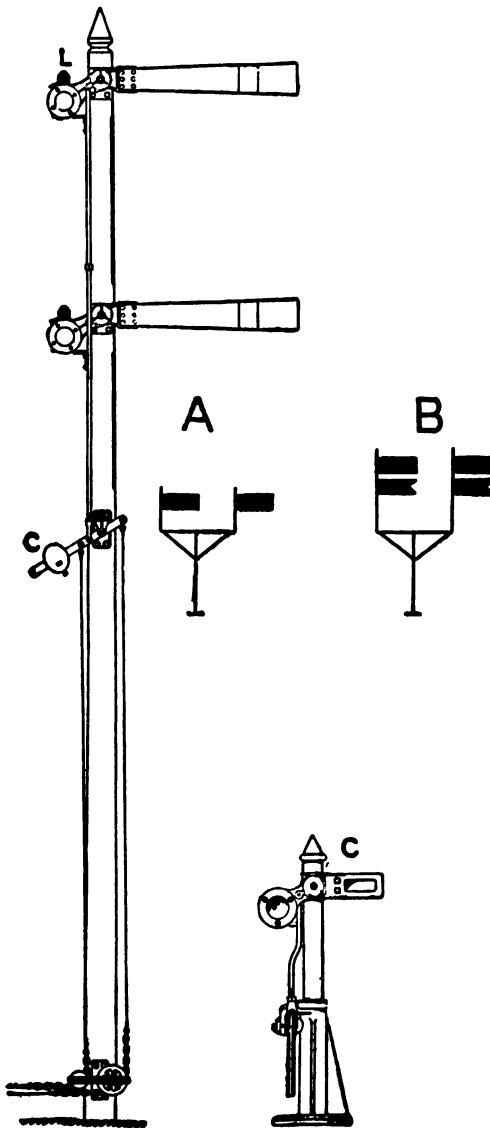


FIG. 2.—Semaphore Signal 24 ft. high; arms in position to indicate "stop." C, counterweight; L, lamp. A—Signals on bracket post for trains moving in the same direction on two parallel tracks. B—Home and distant signals for parallel tracks; home for the section immediately in advance, distant for the section beyond. C—Dwarf signal, for slow movements.

Electric Train Staff.—For signaling on a single track railroad, where it is necessary to provide not only against collisions between trains running in the same direction but also between trains running toward each other, the apparatus of Tyer and of Webb & Thompson is used. In these a "staff" of wood or metal 20 inches long, or a round tablet about 3 inches in diameter, is delivered to the engineman as a

symbol to give the train the right to the track from station to station. Possession of this emblem assures the engineman that no other train is in that section. A magazine filled with staffs or tablets is provided at each end of a block section, and after one of these is taken out (at either end) no other can be taken out, at either end, until the first has been replaced at one end or the other. This control is effected by a lock, governed by a polarized electro-magnet. The magnets at the two stations are electrically connected by a wire, and withdrawal of a staff at either station locks both magazines, while the return of the staff to either unlocks both. The staff system is modified by a "permissive" staff or a staff with tickets; then two or more trains may follow one another in the same direction, while still the entrance of a train from the opposite direction is forbidden. A semaphore signal, giving permission to a train to enter a block section is in some cases interlocked with the staff apparatus, so that the signal indicates "stop" to entering trains until the staff has been taken out of the magazine and used as a key to unlock the signal. These single-track devices are used in England and Australia much more than in America.

Automatic Block Signals.—These are controlled by electro-magnets actuated by an electric current flowing through the rails of that portion of the track which constitutes the section to be protected. From a battery at the out-going end of the section the current flows through the right-hand rail to the signal at the entering end; thence through the coils of a relay at that signal, and back through the left-hand rail to the battery. The track being free from all vehicles, the relay is energized by the current; and by means of magnet *s*, explained below, it holds the signal in the all-clear position. The presence of a train (or car) in the section de-energizes the relay by making a short path for the current, through the wheels and axis, from one rail to another, and this allows the signal to change by gravity from the all-clear to the "stop" position.

The connections for a simple automatic block signal circuit are shown in Fig. 3. The current flows from battery 12, at station C, through the rails on one side to station B, thence by a wire to the relay *r*, through its coils, and thence back to the battery by the rails of the other side of the track. At the ends of block sections (*a*) the rail-ends are insulated one from the other; and all the other rail joints are fitted with bond wires to insure a good electrical conductor throughout the section. At a switch, as at *v*, the track circuit is run through the rails of the side-track for a short distance so that if a car on the siding should be left standing so as to foul the main track, the current would be short circuited, throwing the signal to the stop position. As the insulation of the rails is poor, the battery for a track circuit must be of low intensity. The usual battery consists of two cells, gravity. In many cases the wire 13 by which the relay *r* controls the signal magnet *s* is extended, on poles, to the switch *v*, and to all switches in the section; and the setting of the switch for the side track is made to set the signal against approaching trains. In other cases the breaking of the track circuit at *v* is relied on for this. On a single-track railroad auto-

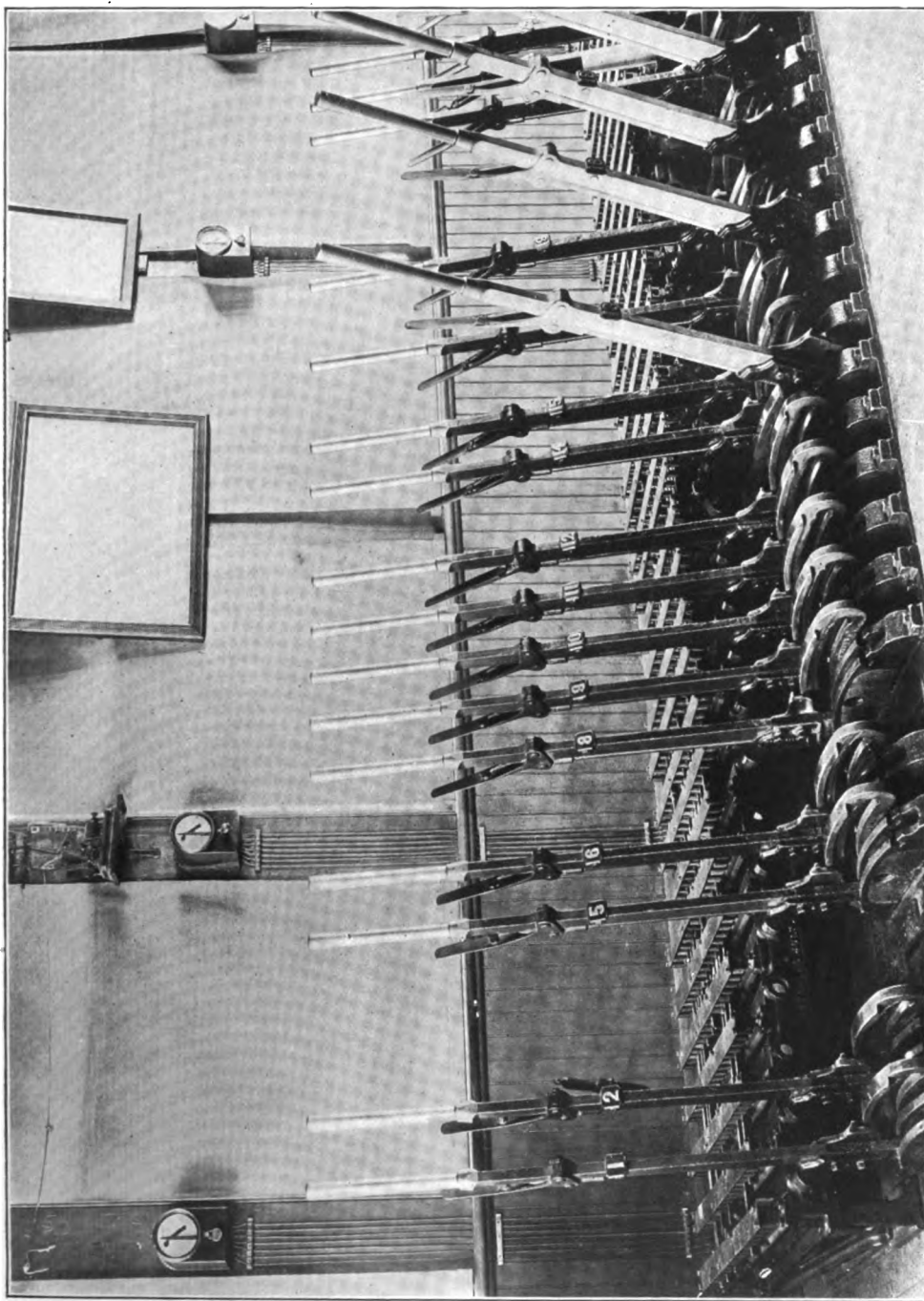


FIG. 9. INTERIOR OF SIGNAL CABIN.

Manual Switch and Signal Levers The locking, back of the levers, is arranged in a horizontal frame. The arrangement in fig. 10 is for a vertical frame.

RAILWAY SIGNALS

matic signals must, of course, be arranged to give indications in both directions, and the relay of a given section not only controls the signal to which it is attached but also, by means of a wire run on the telegraph poles to the other end of the section, it controls a similar signal (on the other side of the track) at the far end, which gives indications to trains moving in the opposite direction. To provide against the possibility of a collision, in case opposing trains should enter a section from opposite ends at the same instant, the track circuit of each section is made to control not only its own signals but one other signal, farther off, in one direction, thus ensuring to at least one of the two trains the warning of two successive signals.



FIG. 4.—Union Automatic Clock-Work Block Signal. Disk, 20 in. in diameter, turning on vertical spindle. The cut shows the signal in the "stop" position; to indicate all-clear it is turned with its edge toward the approaching train. The lamp, turning with the disk, indicates at night white or green for all-clear, red for stop. The disk is made of loose slats to reduce resistance to the wind. The clock-work weight is suspended within the hollow iron post.

The actual movement of the signal is produced not by the track relay with its weak current, but by a weight and clockwork, controlled by magnet *s*; or, electro-magnet *s*, worked by a local battery, may itself be made powerful enough; or an electric motor may be used; or compressed air or gas. The clockwork, and the electro-magnet, were the usual sources of power until the demand arose for a larger signal. The clock-work signal, Fig. 4, is a disk 20 inches in diameter, turning on a vertical spindle.

The signal worked by an electro-magnet is a very light disk enclosed, to protect it from wind, rain and snow, in a case with a glass-covered opening. It turns on a horizontal axis (see Fig. 5).

For a large signal (semaphore) which cannot be protected from wind, rain and snow, compressed air was introduced as a motive power (see Fig. 6). For a series of signals an air compressor is provided at a central point which conveys pressure, through an iron pipe, either buried or above ground, to all of the signals along a section of 10 or 20 miles. Later, electric motors were adapted to this use, doing away with the expense and annoyance of the pipe, and substituting electric power for the compressor. The motor is worked by a primary battery and both motor and battery are usually contained in a box at the foot of the signal post (Fig. 7). A modification of this is the provision of storage batteries, charged through a power wire, conveying current from a dynamo situated at a central point; or, storage batteries may be taken out and carried to a charging station when exhausted.

The electric motor is cheaper than compressed air, but further efforts to reduce cost and to supply each signal with a larger independent reservoir of power led C. J. Coleman to devise the liquid gas signal, in which the motive power is liquid carbonic acid gas, contained in a cylinder under high pressure. The cylinder is put in a pit at the foot of the post. A second cylinder (in the pit) is connected when the first is exhausted, and fresh cylinders are brought as often as needed. A reducing valve regulates the working pressure.

In automatic signaling the distant signals are usually fixed on the same posts with the home signals; for example, the distant signal for signal 11' section C-D is fixed on the post with signal 11, below home signal 11. Signal 11' may control the distant signal at 11 by a current through a wire run on poles, or by a pole changer which when signal 11' goes to the stop position, changes the polarity of the track circuit B-C. In place of relay *r* a polarized relay is used, the relay in its ordinary function controlling the home signal and on the polarized side controlling the distant signal.

On the Boston Elevated railroad, running very frequent trains, and with short block sections and trains of uniform length, an automatic stop is used. This is a device, fixed on the sleepers, working in unison with the block signal, which, when the signal is set to indicate stop, is moved into a position near the rail where it will strike a trip on the leading car and cause the air-brakes to be applied; so that any train which passes a stop signal is stopped in spite of anything that the motorman may do or neglect to do.



FIG. 5.—Hall Enclosed Disk Signal, 18 ft. high. The disk, which shows in the large glass-covered opening, is made of colored silk or celluloid, it indicates "stop." To indicate all-clear the disk is withdrawn from its position in front of the opening. The upper opening is for the night indications; a colored glass is in front of the lamp when the disk indicates stop and is withdrawn when the signal changes to "all-clear."

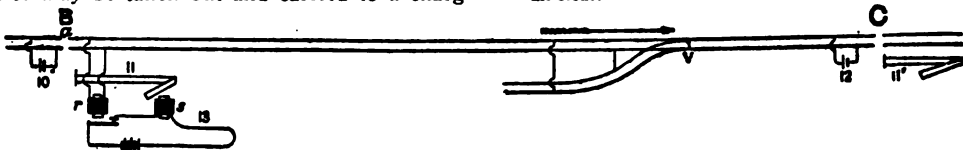


FIG. 3.—Automatic Block Signal Circuit. A section (B-C) is usually from 3,000 ft. to 5,000 ft. long; 10, 12 track batteries; 11, 11' automatic semaphore block signals, in position to indicate all clear; *r*, track relay; *s*, signal magnet; *v*, switch.

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To avoid the expense and complication of a distant and a home signal at every post, the three-position automatic signal was devised. In this, the semaphore arm when horizontal indicates stop, as with other signals; and when vertical it indicates proceed at full speed; but when it is at an angle of 45° , it indicates *stop at the next signal*, which makes it virtually a combined home and distant signal. As a home signal it means (in this last position) "proceed," but as a distant signal it means "stop" (at a point farther on). On electric railroads the rails of the track are used for the return of the powerful electric current used for the propulsion of the cars, so that an arrangement has been devised to control automatic block signals by the use of only one of the rails of the track. By the use of a polarized relay the difference in potential between the left-hand rail and the right-hand is made to control the signal magnet. This arrangement has not yet (1904) come into general use. The electric-light signaling apparatus used on electric railroads do not come within the scope of this article, as they lack important features which signal engineers deem essential to correct signal practice.

Permissive Block Signaling, as mentioned in connection with the electric train-staff, is practised under all of the different systems. With the telegraph block system, stations are usually 2, 3 or 4 miles apart, and when freight trains are unusually numerous, it often becomes necessary to run them nearer together than this, and so a permissive signal is given. The engineman running under such a signal must slacken speed, if necessary, at curves, or in case of fog, so as to avoid the possibility of striking any train ahead. With the controlled manual system the controlling apparatus is useless, if permissive

and there is no signafrican at hand to give positive information as to whether or not the last preceding train has cleared the block section.

Interlocking.—Fig. 8 shows two switches and four signals. To permit the passage of a train,

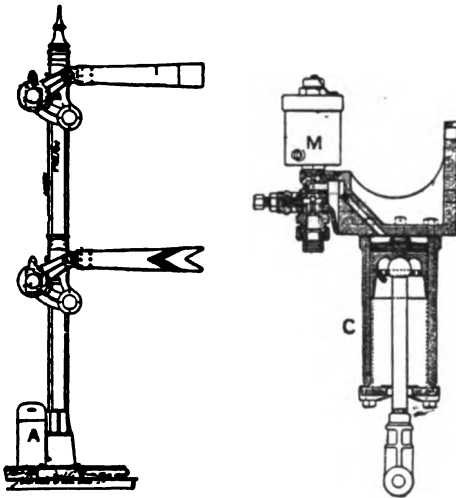


FIG. 6.—Electro-Pneumatic Semaphore Signal (short post to stand on overhead bridge). The signal arms are moved by vertical rods within the tubular iron post. The operating cylinder C is contained in the box A at the foot of the post. Admission of air to the cylinder is controlled by electro-magnet M.

signals are given. With automatic signals it is necessary to allow all trains to proceed permissively after having stopped at a block signal, because the signal may be indicating "stop" on account of some derangement of the apparatus,

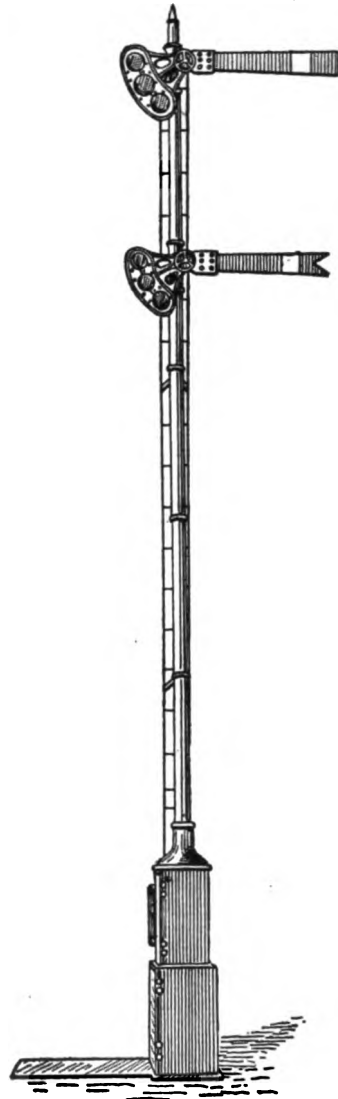


FIG. 7.—Automatic Semaphore Block Signal. The upper part of the box at the foot of the post contains the electric motor and controlling mechanism, the signal arms being moved by rods within the tubular post. The lower part of the box contains the battery for the motor, or, in the case of a gas signal, may contain the gas holders. Of the three glasses in each spectacle, the two upper ones indicate stop, taking the place of a single elongated glass; thus stop is indicated (at night) until the arm moves down fully to the all-clear position.

say train No. 10, along the main line from *a* to *b*, the switch 3 in the main line track must be "straight"; switch 3, in the siding, must also be straight, so that any attempt to move from *c* to *b* (which would foul the path of train No. 10) will be thwarted; and signal 2 must be put in the all-clear or "proceed" position, giving notice to the engineman of No. 10 that the

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switch ahead of him is in the right position. The movement of the levers in this sequence is compelled by the interlocking. Lever No. 2 cannot be moved to clear the signal until lever No. 3 has been put in the right position; lever No. 3, working both switches simultaneously, cannot be moved until lever No. 4, working signal 4, is "home," in which position it must be when that signal is in the stop position, forbidding a train to proceed from *c* eastward. Near each switch there is a detector bar *g*, connected with the lever moving that switch, which prevents the signalman from carelessly changing the position of the switch while a car or engine stands over the detector bar. The bar lies close to the rail, on the outside thereof, and it must be lifted whenever the switch lever is moved; but the presence of a car-wheel will keep it from rising, and thus will prevent the movement of the switch lever. The signal at *i*, with a fish-tail arm, is a distant signal, the function of which has been explained.

Switches are usually connected with the cabin or tower by iron rods (gas pipes) supported a few inches above the ground at short intervals on rollers; signals are connected either by rods or by wires. Bell cranks are introduced where it is necessary to abruptly change the direction of a rod. A long rod or wire must be provided with a compensator to obviate difficulty from expansion and contraction due to changes in temperature. For the rod, a simple

and electric machines have been devised to do the work. Where a manual machine requires, say, five men to work the levers, it is possible, by the introduction of power (which also saves steps by concentrating the levers in a smaller space), for one or two men to do the work. In the Westinghouse electro-pneumatic machine, compressed air, at 70 pounds per square inch, from a reservoir at the signal cabin, is conveyed in pipes, laid underground, to cylinders, one at each switch and one at each signal, in which the pressure, by means of a piston, moves the switch or signal. (A signal cylinder is shown in Fig. 6.) The admission of air to a cylinder is controlled by an electro-magnet fixed at its side, and the circuit of this magnet is controlled by a miniature lever (circuit-closer) in the cabin, the wires, like the pipes, being run underground. These little levers are suitably interlocked, the same as the large levers in a manual machine. The movement of a lever to work a switch does not, however, actuate the interlocking which releases the lever to be moved next; for the lever movement does not insure that the switch has actually been moved, it only closes the circuit. The next lever is held locked, until, by an electric current, the circuit of which is closed by the switch rails themselves, after their movement is completed, the "indication" of such completion is sent back to the cabin, permitting the unlocking of the next lever.

Following the introduction of the electro-

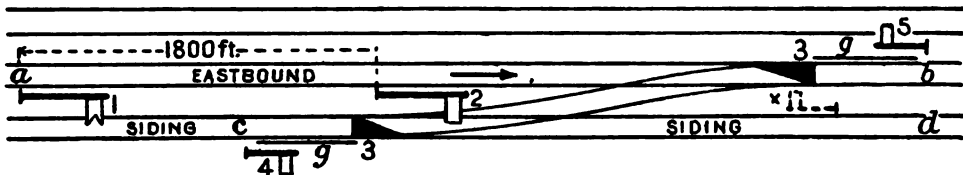


FIG. 8.—Interlocked Switches and Signals.

arrangement of levers, called a "lazy jack," is used. With a wire, the connection at the cabin must be readjusted as often as a change in temperature occurs. A number of more or less satisfactory automatic devices are in use for this purpose.

Where a number of levers are concentrated in a cabin, they are fixed on a common horizontal axis. One such lever is shown in Fig. 10, the axis being at *X*. The interlocking is effected, not by the lever, but by its latch *V*, so that the locking is "preliminary." For example, if the signalman starts to pull lever 3, to move switch 3, the preliminary act of unlatching it locks lever 4 before switch 3 begins to move. Lifting latch *V* moves a vertical rod or tappet *N*; this by means of a mitered dog, moves a horizontal bar in one of the grooves, *G*, a distance of about one inch, and thereby locks lever 4. If lever 4 were in the wrong position, it would obstruct the movement of the horizontal bar, and thus warn the signalman that he was attempting to pull the levers in the wrong order. The horizontal bars are made of any length necessary to reach the farthest lever in the frame, perhaps 50 feet, or more.

Power Switch and Signal Apparatus.—For the very numerous movements in a large yard, like a city passenger terminal, the working of switches and signals by manual power is laborious and comparatively slow, and pneumatic

pneumatic machine, the experiments of F. L. Dodgson showed that the electric current could be dispensed with by using air impulses to control the admission of compressed air to the working cylinders. Air is not so quick as electricity, but it answers all practical purposes at moderate distances. In his machine, the pressure in the power pipes is controlled by a valve, opened and closed by a leather diaphragm, which diaphragm is moved by air conveyed in a separate pipe. In this, the "all-air" system, the pressure in the cylinders is usually only 15 pounds per square inch, and in the small pipes leading to the diaphragm valves, it is only 7 pounds per square inch. The signalman's work consists in opening and closing valves by means of sliding bars (called "levers"); and the interlocking is the same as in other machines.

The "all-electric" switch and signal apparatus was developed by J. D. Taylor. A switch is moved by a one-horsepower electric motor fixed to the sleepers and worked by an electric current conveyed by wires from a dynamo or storage battery in the cabin. For a signal, a motor of one sixth horsepower is fixed to the signal post. The storage battery is usually charged by a generator run by a gasoline engine; and the amount of electric power used is so small that a small engine need be run but a few hours daily.

The machine in the cabin consists of a

RAILWAY, SINGLE RAIL TYPE

frame supporting horizontal sliding bars (called "levers"), each movement closing the circuit to a switch or a signal. The "levers" are interlocked, as in manual or pneumatic machines; and, as in other power machines, the interlocking is controlled by an "indication" sent to the machine from a switch after the switch has

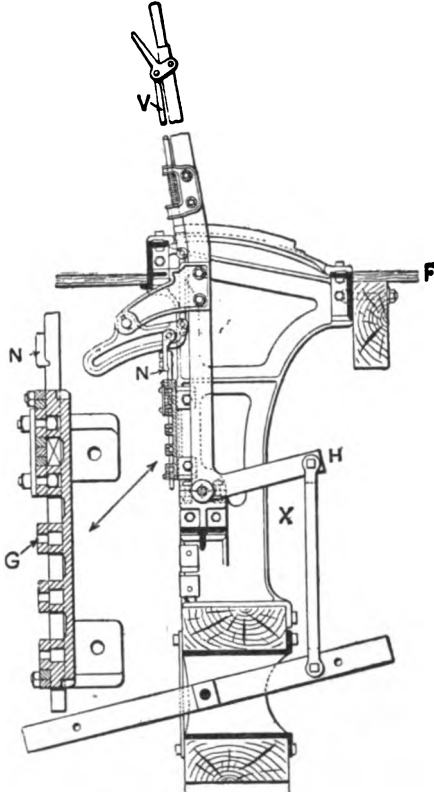


FIG. 10.—Signal Lever and Interlocking Tappet. F, floor of cabin; G, groove for interlocking bar; N, tappet; V, latch rod.

actually completed its movement. This "indication" current is generated by the momentum of the switch motor, which is converted into a generator for a fraction of a second after it has completed its work of moving the switch. The movement of a switch requires a current of only seven amperes. Dwarf signals are worked by solenoids.

The railroads in the United States in 1904 aggregated over 200,000 miles. Of these lines, a length of about 4,400 miles was equipped with automatic block signals. Three fourths of this mileage is double-track railroad and about 300 miles is four-track. On about 22,500 miles of the railroads in the United States, trains run under the telegraph block system. In Great Britain and Ireland, all of the railroads carrying passengers are worked by the telegraph block system. On the continent of Europe, only the more important lines have the block system.

Automatic clock-work signals are used extensively in New England. The enclosed disk signals are used principally in New England and on the Lehigh Valley, the Philadelphia & Reading and the Chicago & Northwestern railroads.

Electro-pneumatic block signals are used extensively on the Pennsylvania Railroad; also on about 30 miles of the Central of New Jersey, and, for shorter distances, on the Burlington and other roads. Electric motor signals are used extensively on the Illinois Central, the Delaware, Lackawanna & Western and the Chicago & Alton, and are being introduced on many other roads. The electro-gas signal is in use on the Delaware, Lackawanna & Western, the New York Central and other roads.

The manual interlocking machines in the United States aggregate about 45,000 levers. The electro-pneumatic interlocking is in use at numerous points on the Pennsylvania railroad, at the two large terminal stations in Boston and at Chicago, Saint Louis and other cities. The "all-air" interlocking is in use at the Grand Central Station, New York, and at large stations in Chicago and other cities. The "all-electric" interlocking is in use at large stations in Chicago and at a large number of smaller places, this system being peculiarly adapted to places remote from a power station.

B. B. ADAMS,
'The Railroad Gazette,' New York.

Railway, Single Rail Type. An important development in railways is that known as

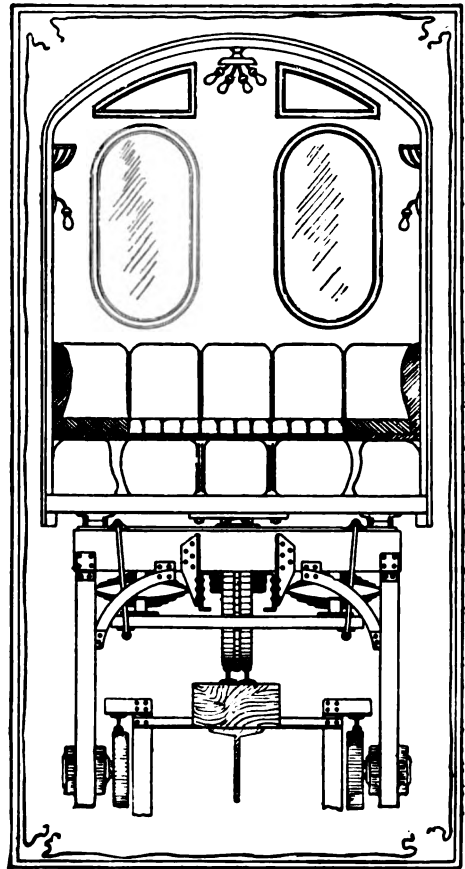


FIG. 1.—American Elevated Railroad System.

the single, central or monorail system. The first idea of a single-rail railway dates back to

RAILWAY, SINGLE RAIL TYPE

one hundred years ago, and many such are now being used in various parts of the world.

The first car run on a single rail, the invention of M. Charles Lartigue, has been in practical operation for many years in Djiboniti, a French African post. The car is kept vertical by its attachment to a laterally placed horse, which



FIG. 2.—The Cook System.

balances the car as a hansom is balanced by attaching the horse in front. The development of this primitive idea attracted the genius of all great civilized countries, and aided by government patronage, individual effort and fortunes, made great progress, but finally corporate wealth and American genius perfected on scientific lines a system which eliminates the possibility of derailment, makes the greatest speed attainable, with comfort, safety and economy.

Technically the system may be described as one where all the different resistances to a swiftly moving car or train, except the atmospheric resistance, are concentrated in the vertical plane of the centre of gravity of the car

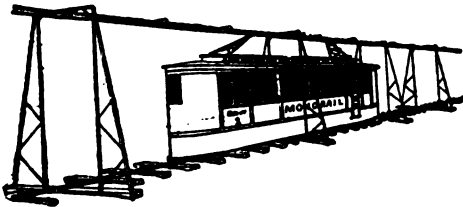


FIG. 3.—The Tunis Monorail.

or train, being partially concentrated by centrifugal force, and those resistances which are not concentrated at the centre are nearly compensated for by friction removing devices. When the said body is at rest, or slowly moving, the unbalanced forces, only, are mechanically concentrated with a minimum friction, and the stability is positively and absolutely preserved without jarring movement. The downward vertical force consists of the weight of cars, trucks and load. This weight is delivered to, and directly sustained by, two centrally disposed bearing rails

laid with precision as to alignment and surface, and closely gauged to each other, so as to constitute practically a single support, while the vertical integrity or stability of the weight thus delivered to a central point is conserved when necessary by upward forces acting through the medium of dependent tension members, fitted with frictionless wheels bearing against inverted girders or rails; when moving at speed, stability is almost entirely preserved naturally and automatically, and only slight strain is on the dependent tension members. The magnitude of the downward forces is a matter simply of weight of cars; the upward forces are a matter of mechanical moments or leverages; the upward forces may amount to 10 per cent of the downward forces for usual cases. The downward force is delivered through the medium of the main central wheel, bearing on the two central rails as on a single rail. The side clutch wheels, that bear against the inverted girders or rails, guide, clutch and secure the car truck to its normal plane or path, forcing the truck to follow precisely any assigned in-

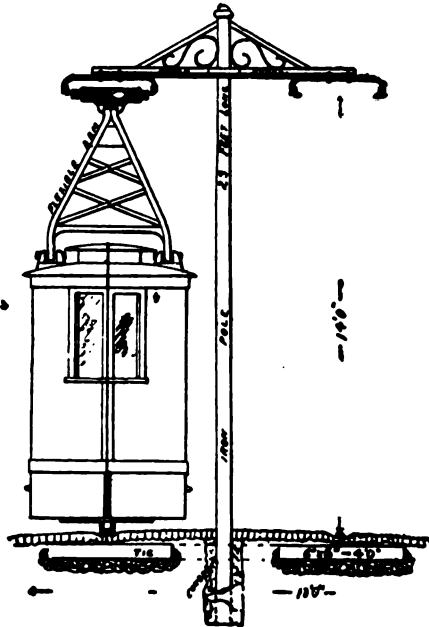


FIG. 4.—For surface street construction, showing overhead truck at the maximum height of 14 feet.

clination; for example, around curves. The central bearing rails and the inverted side clutch rails being laid with precision as to line, grade and inclination, the lateral and top-heavy swaying and recurrent oscillation now observable in locomotives in motion can never obtain; nor can the truck derail, as it is clutched to the track.

Upon the curves, the inverted rails are pitched (the one elevated and the other depressed) to an amount co-ordinate to the radius of the curve and speed. The lateral or tipping tendency of the trucks being always controlled, the car bodies resting upon the truck-bolster will have a base of support free of much pulsatory irregularity of motion now inseparable from moving cars.

The propulsion of cars is effected by electric

RAILWAY, SINGLE RAIL TYPE

motors, two or four motors to each truck, the number of motors being dependent upon the starting pull, acceleration and speed required.

The cars are mounted on two trucks; each runs on two bearing wheels, which follow the same central line; this mechanical sequence is economical of power, or draw-bar pull. The

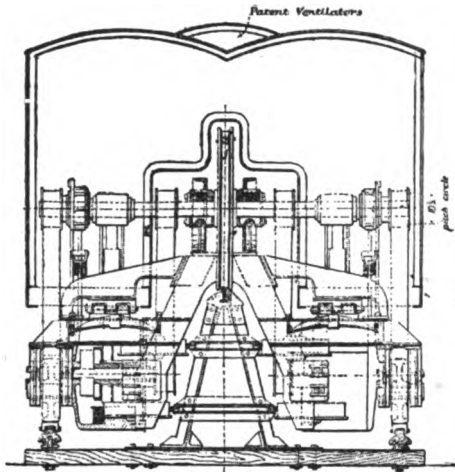


FIG. 5.—Behr System.

inverted rails do additional service as conductors of electrical currents by which the system is operated. This inversion of the charged rails avoids all the difficulties attending the operation of a third rail system.

This system solves the high speed problem, and makes possible the elevation of passenger, mail and express service from overcrowded standard gauge steam roads, converting non-

mend, as overcoming many of the deficiencies of existing railroads and as marking a new departure toward the railroads of the future, with accompanying safety, comfort and economy."

While the monorail system is acknowledged to have reached its highest development in the United States and under the management of the American Elevated Railroad Company, yet no little credit is due to European endeavor and many American inventors. Among the American inventors whose efforts have attracted public attention should be mentioned Col. George S. Broot, of Washington, D. C.; E. Moody Boynton, of Massachusetts; Lina Beecher, of Batavia, N. Y.; William B. Mack, of Boston, Mass.; Howard Hansel Tunis, of Baltimore, Md.; Dr. Adolph Brodbeck, of the University of Nashville, Tenn.; L. F. Cook, and Dr. L. C. d'Homergue, of Brooklyn, N. Y.

William B. Mack's design, shown here, appears to have been awarded more consideration among engineers than any of the many similar plans patented. As far back as 1872 a charter was granted in the State of New York for the building of a hanging railroad which had the general mechanical principles of the hanging roads more recently exploited in Germany, France, and Russia, but the Cook system, shown here, appeared to be the only serious effort made to date at hanging cars on the side of the structure in place of underneath.

E. Moody Boynton patented plans for a monorailway which were approved by such experienced railroad men as Austin Corbin. Several short test roads were built and operated. The Tunis plan here illustrated, is a modification of Boynton's. As will be seen, the single rail is laid on the ground like the rails of steam roads and trolley lines. Over the single rail at fixed intervals are trusses, or bents, joined

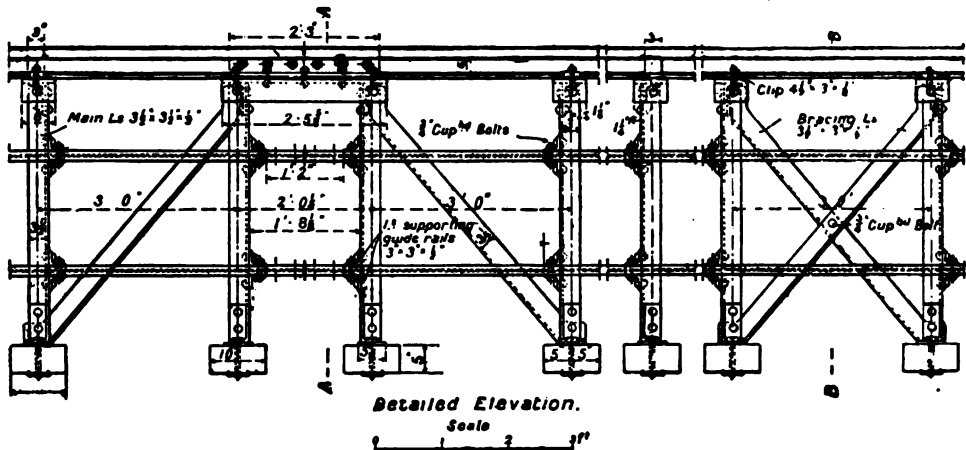


FIG. 6.—Behr System.

paying passenger traffic into the most profitable department of railroad business.

Concerning the monorail system of the American Elevated Railroad Company, described above, Mr. George H. Thomson, M. A. Soc. C. E., M. Inst. C. E., says: "After careful study, guided by years of experience in the location, construction, operation, and maintenance of railroads, I do not hesitate to approve and recom-

by cross pieces at the top and supporting the guides which prevent the car from toppling over. The car itself also embodies some unique and interesting features. It is narrower than the standard trolley or railroad car and rests on a single pair of wheels, or, in the full-size coach, on two trucks of two wheels each, arranged tandem, just under the centre of the floor, the platform and superstructure being balanced on

RAILWAY, SINGLE RAIL TYPE

them. The car is balanced on the single rail, the wheels being of the grooved pattern. So accurately are the weights adjusted that a slight lurch of the body will sway the car from side to side. At first some apprehension was expressed that in going around curves the centrifugal motion of the car would impose too great a strain on the bents, but this fear has proved wholly groundless. By allowing for the centrifugal force by the slant toward the inner side of the circle which is accomplished on ordinary roads by raising the outer rail the weight is thrown off the bents and approximately equalized. A road of this character is now in operation between Washington, D. C., and Wildwood Park, Md., a distance of forty miles.

The English monorail known as the Behr System, here illustrated, has been in operation for a number of years at Ballybunnion, Ireland, and was successfully tested by the Belgian government, securing a speed of 83 miles per hour with a car weighing 70 tons. In 1901 and 1902 the English parliament granted Mr. Behr's company the right to construct a road between Manchester and Liverpool, after the plans had been examined and approved by many eminent

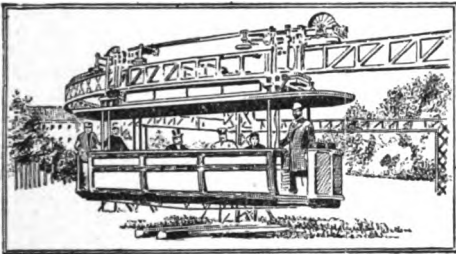


FIG. 7.—Romanoff System.

engineers. The plans as will be seen by the illustrations, appear complicated.

The road is now being built, and will soon be in operation. It will extend from Manchester to Liverpool, and is patterned after the road which was operated at the Brussels exhibition in 1897, which was three miles long, and on which a speed of 83 miles an hour was frequently made. As this line was very crooked, it was not adapted to as high speed as the Manchester-Liverpool road, which has few curves.

The track is a single rail of the same shape and weight as generally used on steam roads. This rail is fastened at the top of an A-shaped structure made of steel. The structure is riveted to steel ties firmly imbedded in cement and rock ballast. The triangular supports for the rail are only 4 feet high, and one is placed every 3 feet 3 inches. At each side and 18 inches from the ground is placed a light guide rail to keep the moving car in position. The entire weight of the car rests upon large grooved wheels which travel upon the large rail at the top of the framework. As electric motors will be used to propel the train, each of these wheels will be made a "driver." Current is conducted on rails placed upon the ties, but insulated from them.

The car consists of two compartments, one on each side of the structure, and are 60 feet long, weighing four tons each. They will seat

32 passengers, who will sit with their backs to the track. No stops will be made between Manchester and Liverpool, and it is expected to make the trip of 34 miles in 20 minutes, which is just one half the best time now made by the steam road running between these cities. Two tracks will be provided, one for use in each direction, and only passengers, mail and light parcels will be carried.

The monorail idea has been exploited in Germany, France, and Russia in its application to hanging cars, but Germany alone has secured results. A suspended overhead railway system of rapid transit is now in operation between the three manufacturing towns of Vohwinkel, Eberfeld and Barmen, near Cologne, Germany. The road is built on a system of latticed longitudinal girders, one vertical and two horizontal, assembled into the form of an I-section. The main girders form the web of the I, and the lateral girders, which give the requisite lateral stiffness, serve as the top and bottom flanges of the I. Diagonal tie-rods extend from the upper panel points of the central girder to a connection with the chords of the bottom lateral girder. The last mentioned chords consist of steel I-beams, and upon their upper flanges is laid the single T-rail, from which the cars depend and on which they run. The girders, which vary in span from 21 to 33 meters (68.88 feet to 108.24 feet), are carried upon supports varying in structure with the locality where they are used. Where the railway is carried immediately above the Wupper River the A-frame style of pier is used, while in the towns through which the line passes the trusses are carried upon substantial U-frames. The A-frame consists of two rectangular latticed struts, which are united at the top by a rectangular plate yoke.

The supporting structure of the road, including trusses and piers, has an average weight of about 2,000 pounds per yard, which is due primarily to the great length of the girders and



FIG. 8.—Suspension Railway, Barmen, Germany.

unusual height of the supports at Elberfeld. Under more favorable conditions this weight could be reduced.

The cars are 37.7 feet long, 8.5 high and 6.88 feet wide; are therefore fairly long and narrow, and are slightly tapered at the ends.

They have a seating capacity of fifty, and are built with two side doors opening inwardly, and two auxiliary doors at the ends. The total weight of each car is twelve tons. The cars are freely suspended from two trucks spaced eight meters apart and having a diameter of 0.9 meters. The wheels are mounted in tandem to run on a single rail, and are driven by two electric motors of 36 horse power each, through

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the medium of transmission gearing. The motor trucks receive current by means of a slipshoe and a contact rail, which is carried on the bottom of the lateral girder, somewhat to the inside of the main supporting beam.

The truck-frames embrace the rail-girders and the rails so closely that a play of seven millimetres is allowed and that derailment is impossible. If a wheel or axle should break the cars would be held up by the frames.

Oscillation of the car is limited by two projections on the lower part of the hook-shaped frame. The cars swing around the curve in a slightly inclined position and spontaneously re-assume their normal vertical position when a straight part of the rail is reached. To the passengers the change in equilibrium is imperceptible. Since a sudden change in equilibrium causes an oscillation proportionate to the velocity and the angle determined by the radius of the curve, which oscillation lies within twice the value of this angle, comparatively long transitional bends have been provided by reason of which the equilibrium is gradually changed, with the result that almost inappreciable oscillations are produced.

There are eighteen elevated stations on the line. This elevation was necessary in order not to interfere with street traffic in the towns. The rails run straight through the stations.

A Russian electric engineer named Hippolyte Romanoff has invented a monorailway of some merit. The invention consists of a monorail hanging car as shown here. The rails are supported by T-shaped columns, the carriages being suspended in the air and propelled by wheels running along the rails. These wheels are without flanges, which Romanoff asserts retard speed by clinging to the rails while rounding curves, but are prevented from leaving the rails by means of smaller wheels which grip the rails horizontally.

An electric feed-wire runs parallel with the rail. The cars have three supports each. If the first is broken the second comes into play automatically, and then the third. Should any one of the cars be stopped by an accident or for any reason other than the natural one of pausing at a station, all the cars behind would stop also, thus preventing any rear-end collisions.

In all the various applications of the monorail it has been fully demonstrated to the satisfaction of many of the world's most eminent engineers, that for speed, comfort, safety, and economy it excels any other form of railway yet devised.

Railway Spine. See NEURASTHENIA, TRAUMATIC.

Railway Surveying. See SURVEYING.

Railway Systems in the United States.

History.—From the time of Hero, 2100 years ago, locomotion by steam has been the subject of much thought and experiment, but until Sir Isaac Newton proposed his steam carriage in 1680, there was little or no practical accomplishment. In 1769 the first self-propelled carriage was built by Nicholas Joseph Cagnot, a French army officer. This had two vertical single-action cylinders, and was the first known application of a high-pressure engine. From this time on there was continuous progress in

mechanical traction, and although the first locomotives were small and crude, their employment as an agent of transportation marks one of the world's greatest advances. The railways at the beginning were simple tramways equipped with tracks composed of wooden rails. Prior to 1809, Oliver Evans, of Philadelphia, urged repeatedly in public addresses the construction of a passenger railroad from Philadelphia to New York, and in that year attempted to form a company for this purpose. The State of New York, in April 1823, chartered the Delaware & Hudson Canal Company to construct a canal and railroad from the coal fields in Pennsylvania to the Hudson river at Rondout; the railroad, 16 miles long, from Honesdale to Carbondale, to carry coal, was completed in 1829. In 1826, the Quincy railroad in Massachusetts, four miles long, was built to haul granite to the port of Neponset; the rails were of wood, strapped with iron. In 1827, the Mauch Chunk railroad, nine miles long, was built in Pennsylvania to connect coal mines with the Lehigh river; the gauge was three feet seven inches, and the wooden rails were faced with iron. In 1826, the State of New York chartered the Mohawk & Hudson railroad, for freight and passengers, from Albany to Schenectady, 17 miles; work was begun in 1830, and the road was opened for travel in 1831. In 1827, the State of Maryland chartered the Baltimore & Ohio railroad. Work was begun in 1828, and in 1829 the track was finished six miles, and "cars were put upon it for the accommodation of the officers, and to gratify the curious by a ride." This was the first road in the United States that was opened for the conveyance of passengers; it was finished to Ellicott's Mills, 13 miles, in 1830. The Washington branch was opened to Bladensburg in July, and to Washington in August, 1834. The Charleston & Hamburg railroad, in South Carolina, was chartered in 1827. A locomotive was placed on it in 1830. The road was completed in September 1833, a distance of 135 miles. At that time it was the longest continuous line of railroad in the world. The track of the Baltimore & Ohio consisted of cedar cross-pieces and string-pieces of yellow pine 12 to 24 feet long and six inches square, with iron bars on them. The flanges of the wheels were on the outside. After some miles of this kind of road had been made, long granite slabs were substituted for the cedar cross-pieces and pine stringers. "Iron strips were laid for miles and miles on stone curbs." Before the road had been finished to Point of Rocks in 1832, "wrought-iron rails of the English mode" had been laid on part of the line. Many years passed before any other than flat rails were made in America. All the heavy rails were imported from England. Up to 1843 there were no facilities for the manufacture of heavy iron rails to supply the wants of the 4,185 miles of American railroad then existing, and of a few hundred additional miles then projected. The first heavy rails were rolled in 1844, of the U pattern, at the Mount Savage Iron Works in Maryland. The first T-rails made in America were rolled at the Montour Mill, at Danville, Pa., in 1845. The T-rail, now universally used on American railroads, is generally supposed to be of English origin, but it was invented by Robert L. Stevens, of Hoboken, N. J., in 1830, and was first

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laid on the Camden & Amboy railroad. It did not come into general use until after 1845. The first made of these rails were only 16 feet in length. The first rails, 30 feet in length, were made at the Cambria Iron Works, at Johnstown, Pa., in 1856. The first 60-foot or double-length rails were rolled at the Edgar Thomson Steel Works, Pennsylvania, in 1875, and that company, in 1876, exhibited a steel rail at the Centennial Exhibition, 120 feet in length, weighing 62 pounds to the yard. See RAIL SECTIONS; RAILS AND STRUCTURAL SHAPES; ALUMINO-THERMICS.

The construction and development of the locomotive has kept pace with railway building in America. The English locomotives were expensive, could not be secured promptly, and were not well adapted to the light rails, steep grades, and sharp curves of the American tracks. Traffic conditions necessitated construction according to designs entirely different from those followed in Great Britain. Starting with Peter Cooper's one-ton locomotive, the *Tom Thumb*, which made its first run in August, 1830, between Baltimore and Ellicott's Mills, the locomotive has passed through every stage of development and enlargement, until now the designer stands between two fires. On the one hand is the motive power department calling for locomotives of ever-increasing tractive power; on the other hand, is the maintenance of way department setting a limit as to the weight of engine allowable. The two demands are largely contradictory, but the balanced compound locomotive gives relief in both directions. The economy gained by compounding gives greater power per unit of weight of engine, and the perfect balancing of the moving parts gives an engine which, compared weight for weight with a single expansion, is very much easier on the track. Traffic requirements are still calling for rolling stock of greater capacity and the monster 400,000-pound locomotive must continue to grow until the highest factor of efficiency and lowest possible ton-mile cost of haulage is reached. See LOCOMOTIVE, THE; LOCOMOTIVE ENGINE; LOCOMOTIVE AND ENGINE INDUSTRY; LOCOMOTIVES, COMPOUND.

The gold of California gave great impetus to railroad projects until the commercial crisis of 1857 and the Civil War seriously interfered. With the return of peace, however, there was a marked revival. The transcontinental route over the Union Pacific and the Central Pacific roads was opened in 1869, and construction then became most active in the Northwestern States. A similar revival followed the crisis of 1873. By 1880 the principal field of activity was in the Southwestern and Rocky Mountain regions and in 10 years, to 1890, the railroad mileage of the country had increased from 93,000 to 164,000 miles. Each section of the country, as it filled up with competing roads, witnessed a period of secret rebates and receiverships and the gradual consolidation of intermediate links into long lines occupying the principal thoroughfares and controlling their own feeders. The consequent stifling of competition early led to the establishment of State commissions and the Interstate Commerce Commission. (See COMMERCE, INTERSTATE.) The vigorous campaign against the Commission has been carried into the Supreme

Court with indecisive results—and the war is still on.

Railway Groups.—The railway system of the United States, as a whole, may be divided into groups, each group occupying a distinct section of the country. (See AMERICAN RAILROADS.) This classification gives little information regarding ownership and management. The following tabulation, influenced by community of interest or harmony of action, shows the present progress of groupings of systems. These groups are not antagonistic, but are rather intertwining circles of influence and control, all being irresistibly drawn toward a common centre:

	MILES.
Morgan	26,393
Vanderbilt	20,520
Vanderbilt-Morgan	7,877
Pennsylvania	16,675
Pennsylvania-Vanderbilt-Morgan	4,746
Harriman-Hill-Morgan	20,187
Harriman	23,051
Seaboard Air Line	2,625
Rock Island	14,966
Gould	16,527
Atchinson	8,615
St. Paul	6,682
Minneapolis-St. Louis	3,118
Missouri, Kansas & Texas	3,005
Pere Marquette	2,351
Chicago Great Western	1,464
Wisconsin Central	1,043
Aggregate	179,845

The lines in the Morgan group are the Southern (including the Mobile & Ohio, 874 miles), 9,302 miles; the Atlantic Coast line (including the Louisville & Nashville, 6,133 miles), 10,703 miles; Central of Georgia, 1,877 miles; Chicago, Indianapolis & Louisville, 556 miles; the Lehigh Valley, 1,399, and the Erie, 2,556 miles.

The Vanderbilt group includes the New York Central (with the Lake Shore, 1,411; Michigan Central, 1,653; "Big Four," 2,235; "Nickel Plate," 523, and the Lake Erie & Western, 725 miles), total, 11,079 miles; also Chicago & Northwestern, 8,971 miles.

The Vanderbilt-Morgan lines are the Delaware, Lackawanna & Western, 824 miles; Delaware & Hudson, 966; New York, New Haven & Hartford, 2,037; New York, Ontario & Western, 549; Boston & Maine, 3,298, and the Pittsburgh, Bessemer & Lake Erie, 203 miles.

The Pennsylvania group includes the Pennsylvania system, 10,566 miles; the Baltimore & Ohio, 4,397, and the Norfolk & Western, 1,722 miles.

The Pennsylvania-Vanderbilt-Morgan lines are the Chesapeake & Ohio, 1,641 miles; the Reading, 2,145, and Hocking Valley, 960 miles.

The Harriman-Hill-Morgan roads are the Great Northern, 5,888 miles; Northern Pacific, 5,976, and the Burlington, 8,323 miles.

The Harriman group are the Illinois Central, 5,463 miles; Chicago & Alton, 915; Chicago Terminal Transfer, 108; Kansas City Southern, 839; Union Pacific, 6,105; Southern Pacific, 9,621 miles.

The Rock Island group includes the Rock Island, 7,298 miles; St. Louis & San Francisco, 5,663; Chicago & Eastern Illinois, 752; Evansville & Terre Haute, 331, and lines in Texas, 922.

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The Gould group includes the Missouri Pacific, 6,006; Texas & Pacific, 1,973; Denver & Rio Grande, 2,460; Saint Louis Southwestern, 1,511; International & Great Northern, 1,130; Wabash, 2,483; Wheeling & Lake Erie, 520; West Virginia Central & Pittsburgh, 177, and Western Maryland, 258 miles.

These groups are growing lesser and lesser while the consolidation process is going rapidly on. Should all the interests come together, the gigantic combine will crumble of its own weight, as did many of the railroad systems so elaborately built up 20 years ago. The wisdom of the present may not see the remedy, but earnest thinkers look upon government control or regulation of railways as the only way to establish and maintain equitable relations between the carriers and the people whom they serve.

Ownership.—The actual ownership of American railway securities is vested in about 350,000 people, these holdings ranging from a few shares to more than 40,000. The control of the roads, notwithstanding the ownership through stockholdings distributed among such a large number of individuals, rests with fewer than a score of people representing four or five of the great business houses on Wall street. The following table shows the number of stockholders of record of 30 important railways of the country:

NAME OF COMPANY.	NUMBER OF STOCK- HOLDERS IN 1904.
Pennsylvania	44,175
Atchinson, Topeka & Sante Fe	17,823
Union Pacific	14,256
New York Central & Hudson River	11,872
New York, New Haven & Hartford	10,842
Southern	9,572
Illinois Central	9,123
Boston & Albany	8,417
Boston & Maine	7,402
Baltimore & Ohio	7,132
Fitchburg	6,099
Chicago Great Western	5,977
Chicago, Milwaukee & St. Paul	5,851
Lehigh Valley	5,777
Old Colony	5,371
Erie	4,309
Chicago & Northwestern	4,109
Delaware & Hudson	3,819
United New Jersey	3,585
Norfolk & Western	2,911
Denver & Rio Grande	2,910
Pittsburgh, Fort Wayne & Chicago	2,642
Morris & Essex	2,450
New York, Ontario & Western	2,437
Southern Pacific	2,424
Concord & Montreal	2,356
Boston & Lowell	2,168
Northern	2,068
Cleveland & Pittsburgh	2,041
Chicago & Alton	2,039

The following 27 companies each have stockholders ranging between 1,000 and 2,000, as follows:

NAME OF COMPANY.	NUMBER OF STOCK- HOLDERS.
Pere Marquette	1,984
Mine Hill & Schuylkill Haven	1,974
Wabash	1,974
Cleveland, Cincinnati, Chicago & St. Louis	1,965
Missouri Pacific	1,861
Louisville & Nashville	1,672
Atlantic & St. Lawrence	1,661
Boston & Providence	1,654
Delaware, Lackawanna & Western	1,575
Cincinnati, Hamilton & Dayton	1,558
St. Louis & San Francisco	1,521
Missouri, Kansas & Texas	1,509
Hocking Valley	1,503

NAME OF COMPANY.	NUMBER OF STOCK- HOLDERS.
Chesapeake & Ohio	1,478
Vermont & Massachusetts	1,313
Northern Central	1,199
North Pennsylvania	1,100
Rome, Watertown & Ogdensburg	1,094
Huntington & Broad Top	1,071
New York, Lackawanna & Western	1,070
Little Miami	1,064
Rutland	1,058
Chicago, St. Paul, Minneapolis & Omaha	1,045
Utica, Chenango & Susquehanna Valley	1,042
Georgia Railroad	1,038
Philadelphia, Germantown & Morristown	1,035
Wheeling & Lake Erie	1,004

The value of railroad securities held by insurance companies, saving institutions, and educational institutions, exceeds \$1,500,000,000, and inasmuch as these fiduciary holders represent large bodies of individuals and some holding companies whose own shares are widely distributed, it is readily seen how materially the business life of the nation is based upon railroad values and how widely diffused is the railroad ownership. See RAILWAY RECEIVERSHIPS AND REORGANIZATIONS; RAILWAY SECURITIES.

Mergers.—The permanent control of a railroad corporation may be accomplished by depositing a majority of its stock with a holding company. This plan is utilized as an indirect means for the consolidation of several companies, by the ostensible sale of sufficient shares of each company to a corporation formed for that specific purpose. This device has been expanded, in the notable instance of the Northern Securities Company, to controlling the operation of rival lines extending from Chicago to the Pacific ocean. In the spring of 1901, the Northern Pacific Railway Company and the Great Northern Railway Company, two roads which were regarded as parallel and competing lines, united in purchasing nearly the entire capital stock of the Chicago, Burlington & Quincy Railway Company, becoming joint sureties for the payment of the bonds of the Chicago, Burlington & Quincy Railway Company, whereby the purchase was accomplished. In November, 1901, the Northern Securities Company was organized under the laws of the State of New Jersey, with a capital stock of \$400,000,000. Shortly after its organization that company acquired a large majority of the stock of the Northern Pacific Railway Company, and also a majority of the stock of the Great Northern Railway Company, paying for these stocks with its own stock. A suit was brought by the United States against the Northern Securities Company in the Circuit Court of the United States for the circuit of Minnesota. On 9 April 1903, that court held that all the stock of the Northern Pacific Railway and Great Northern Railway Companies held and owned by the Northern Securities Company was acquired in virtue of a combination or conspiracy in restraint of trade prohibited by the Sherman Anti-trust Act. Its officers, agents, etc., were enjoined from voting the aforesaid stock, or from attempting to vote it at any meeting of the stockholders of either of the railway companies, etc. The decree, however, allowed the Northern Securities Company to return and transfer to the stockholders of the Northern Pacific Railway and Great Northern Railway Companies,

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respectively, all the shares of stock in either, which the Northern Securities Company had received in exchange for its own stock. An appeal having been taken from this decision to the Supreme Court of the United States, that court on 14 March 1904, affirmed the decision of the lower court. See RAILWAY CONSOLIDATION.

Valuation of Railways.—The aggregate railway capital in the United States on 30 June 1904, as measured by the par value of outstanding securities, was \$13,213,124,679, which shows a capital of \$68,553 per mile of line, including liabilities. In arriving at the actual valuation of railways, well-defined rules are followed: (1) Inventory valuation applies only to a limited degree. (2) Income valuation is the only true basis of calculating a railroad value. Every item of assets, except those of a distinctly detachable character, is contributory to the general income account and gets its value there. (3) Cost of duplication is only discussed where the line is obviously obsolete in standards of grade and curvature and where the menace of competition at less cost by a better-equipped rival is real. (4) The property accounts of road and franchises are only indirectly considered on the basis of net stock and debt capital per mile of line set against like figures of competitors in the same territory. Questions of actual investment and past costs are practically ignored. The whole consideration is limited to present and future earning power under present and future competitive conditions. Competitive pressure is not supposed to be applied at the maximum at every point; that is, every mile of road is not revalued at an estimated cost of present duplication by a parallel construction under most modern and most favorable conditions. As a practical proposition such duplication is recognized as financially impossible. It could only occur at certain places. Because it may be good enterprise and socially economical to parallel 500 miles of line at present cost of duplication, it does not follow that it is good enterprise and socially economical to do the same for 15,000 miles. The possibility of actual competition for the 500 miles cannot apply with equal force as potential competition to reduce the value of the remaining 14,500 miles.

Gross Income and Its Application.—The total railway capital of the United States in January, 1906, was \$10,973,524,903. The gross income of \$1,900,846,907, for the year 1905, was applied as follows:

Pay of employees.....	\$775,321,415
Fuel for locomotives.....	146,509,031
Oil, etc., for locomotives.....	7,798,642
Taxes.....	57,849,569
Permanent improvements.....	41,948,183
Deductions and deficits in weak lines....	44,681,341
Locomotives, renewals and repairs.....	50,000,000
Freight car renewals and repairs.....	50,000,000
Passenger car renewals and repairs.....	15,000,000
Bridges.....	20,000,000
Rails.....	12,000,000
Ties.....	20,000,000
Ballast.....	10,000,000
Buildings.....	15,000,000
Loss and damages.....	13,726,508
Payments for injuries to persons.....	14,052,125
Hire of equipment, car service, etc.....	20,253,915
Rents for tracks, yards and terminals...	19,375,606
Rents for buildings and other property...	5,151,801
Train and station supplies.....	27,856,669

Shop tools and repairs.....	\$8,739,157
Legal expenses.....	6,783,692
Stationery and printing.....	11,232,405
Advertising.....	5,376,368
Miscellaneous expenses.....	8,791,765
Interest on bonds.....	277,891,403
Dividends.....	166,176,486
Surplus income.....	49,330,740

Total..... \$1,900,846,907

Equipment and Employees.—Enormous quantities of rolling stock are required to equip the 212,000 miles of railway in the United States. Locomotives number 41,000, of which 10,000 are in passenger service, 24,000 haul freight, and 7,000 are required for special service. There are 37,000 cars needed to move passengers, and 1,600,000 cars to carry freight. (See CAR BUILDING INDUSTRY; STEEL CAR INDUSTRY.) Were all these engines and cars in use at the same time there would be a passenger train for every 21 miles of road in the United States, and a freight train for every nine miles. End to end the passenger equipment would make a solid train 500 miles long. The freight cars and engines would make another train about 9,000 miles long, or nearly three times the entire distance from the Atlantic to the Pacific. A thousand million miles is covered by the various trains during the year—450,000,000 by passenger trains and 550,000,000 by freights. The mileage of the individual freight cars makes a distance inconceivably great. They run far enough to girdle the earth at the equator each minute, day and night, every day in the year, or an aggregate of 40,000,000 miles a day and over 14,000,000,000 miles a year.

The freight trains of the nation carry 1,250,000,000 tons of goods during the year in an average haul of 135 miles per ton. This means that they transport a total of about 170,000,000,000 ton miles. With every second of time the railroads do enough work to transport a ton of goods 540 miles, or half the distance from New York to Chicago. It would take 25,000,000 teams and their drivers to do as much. The work performed by the railroads, if done in the old way, would require two and a half times as many horses and mules as there are at present in the entire nation, and practically the entire male population over 15 years old. On the whole, so enormous are the demands of our modern civilization, that to feed, clothe, shelter, and provide the various needs and luxuries of the people requires the transporting of a ton of goods 280 miles every week in the year for each family of the nation. The railroads charge the enormous sum of \$1,250,000,000 a year for doing this work. Yet this is only three-fourths of a cent for carrying a ton of goods a mile. This estimate does not take account of the passenger service. The railroads take toll amounting to \$400,000,000 a year for carrying passengers. But to earn this money they transport 700,000,000 passengers an average of 30 miles each. This is an aggregate of 21,000,000,000 passenger miles a year, or 700 miles with every stroke of the clock. The railroads thus average about two cents a mile for each passenger carried. See RAILWAY TARIFFS; RAILWAY (ELECTRIC) ECONOMICS; RAILWAY INTERCHARGE CAR SERVICE.

To carry on this enormous traffic requires an army of 1,250,000 men, and their yearly pay

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aggregates \$750,000,000. Among these workers are 10,000 presidents, vice-presidents, general managers, and other general officers, and 40,000 general office clerks. There are 35,000 station agents and 110,000 other station men. There are 30,000 telegraph operators. The care of tracks requires 35,000 section foremen and nearly 300,000 track walkers. Watchmen, flagmen, and the like, number 50,000. To keep the trains and buildings in order requires 40,000 machinists, 50,000 carpenters, and 140,000 other shop men. The actual running of the trains requires 225,000 men, or about one in every five of the total number of railroad employees. Of the men 50,000 are engine men and as many more are firemen. There are 35,000 conductors and some 90,000 other trainmen.

Safety Devices.—In the last few years the phenomenal increase in tonnage hauled on American railways has necessitated the purchase of more and better engines and cars of larger capacity, equipped with the best safety devices. Enormous sums have been expended in taking out curves, cutting down grades, laying additional main tracks, putting in new sidings and providing improved terminal facilities. (See RAILWAY ENGINEERING; STREET RAILWAY CONSTRUCTION; RAILWAY PASSENGER STATIONS.) But, notwithstanding all these improvements, many lines find it impossible to handle their business with sufficient dispatch to avoid congestion. This fact has led many progressive American railway managers to realize that if they are to secure the best and most economical returns from the great expenditures made for motive power, car equipment and tracks, suitable means must be provided to enable their trains to move with a minimum of delays and a maximum of safety; and this can only be realized when train orders are supplanted by an up-to-date block system and hand-operated switches by a modern system of interlocking.

The very highest development of the art of signaling has been reached in this country, but no American railway line is nearly so thoroughly equipped with signaling as is the average English line. (See RAILWAY SIGNALS.) The first interlocking plant installed on the London and Northwestern railway was put in service in 1859; 14 years later, in 1873, there were in use on that line alone 13,000 levers. At the same date there was not a single interlocking plant in use in the United States, the first plant in this country having been installed in the year 1874, at Spuyten Duyvil Junction, in New York city. At the present time there are in use on the 1,800 miles of line of the London and Northwestern railway approximately 36,000 interlocked levers, or an average of about 20 levers per mile of line, whereas there are only about 40,000 in use on all lines of the United States, or, approximately, one lever to five miles of line.

The tests recently made at West Seneca, N. Y., have served to demonstrate the net results attained in providing brakes and draft gear fully adequate for service under modern conditions, and to perfect other new devices no less important from an economical and operating standpoint. During the 15 years that have elapsed since the quick-action automatic brake came into general use on freight trains, the average weight of locomotives on drivers has

increased from 100,000 to 200,000 pounds, and their draw-bar pull from 25,000 to 50,000 pounds. Within the same period the average freight car capacity has increased from 40,000 pounds to 100,000 pounds; and while in 1888 50 cars in a train was considered a maximum, now 80 is common and 100 by no means rare. Reference to these figures is scarcely needed to emphasize the statement that brake apparatus which met all requirements 15 or 20 years ago is now satisfactory only in inverse proportion to the increased demand made upon it. So far as draft gear is concerned the proposition is self-evident.

Port Differentials.—The Atlantic seaports of New York, viz.: Philadelphia, Baltimore, Newport News, Norfolk, Wilmington, Charleston, Savannah, Brunswick, Jacksonville, Pensacola, Mobile, New Orleans, and Galveston are all competitive with New York and Boston for import trade. The southern ports named contend that, owing to various advantages enjoyed by New York, their business is dependent upon their ability to secure slightly lower inland rates than those to New York. This has long been admitted in practice by the railways, and differences have been made in their favor. Those who support the effort to secure a new law do so because they believe it would result in the prompt abolition of these differentials and so enable Boston and New York to secure a much greater share if not in fact to monopolize the export trade of the country. The principle of a fixed difference being now called into question after 26 years of more or less irregular use speaks volumes for the vitality of the arrangement.

Private Car Lines.—In reference to the agreements between railroad companies and the owners of private cars, it may be accepted as true that such agreements are in the main equitable, and favorable to the public so far as the peculiar circumstances of the case permit. The contentions which the private car lines are now making may have some justification. Perhaps being only indirectly engaged in interstate commerce they may not be subject to the law as it stands. That is a question for judicial determination. But there can be no reasonable doubt that it is within the power of Congress to say that these private car lines shall be regarded as engaged in interstate commerce and thus subjected to the statutes regulating such commerce. It cannot be admitted that private companies may be organized to carry on a regular system of transportation between the States, establishing what rates they please for the service and practising discriminations contrary to law, without being subject to any restraints or control or regulation. To concede that would be to give warrant for monopoly with the privilege of unrestricted abuses. The private car lines are unquestionably engaged in interstate commerce. The cars of these lines transport products between the States and the fact that they are leased to the railroads does not affect the character of their service.

Government Control.—Government control and operation are legally justifiable, if at all, under the commerce clause of the Constitution. But under judicial interpretation the power conferred by that clause is already so swollen as to dwarf almost every other national power. Its

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original purpose and scope were to prevent hostile commercial legislation by one State as against another and to make all the States but one country in their commercial relations with foreign nations. On this comparatively slight foundation has been built an edifice at sight of which, could it have been brought within their vision, the framers of the Constitution would have stood aghast and which would have doomed the Constitution to inevitable defeat. Under the present construction of the power, liberties and rights of contract once deemed inviolate are subordinated to its exercise and are not even protected by the constitutional amendments adopted for that express purpose. If Congress might lawfully do it, it certainly would be wise for that body to pause before making the experiment of endowing a commission with a jurisdiction which might well make it more powerful than the government itself. That the tendency in that direction would be strong admits of no question. To have even a semblance of competency the commission must have a reasonably permanent tenure of office. Its authority would grow with every year of its life, and before any long time would make its members the most important body of men in the country. No industry could afford not to be in touch with such commission, and every corporation, association, firm, or individual engaged in important commercial or manufacturing enterprise would be compelled to cater to it. In alliance with more or less of the great industries, it would be in a position to influence political conditions and to make itself strongly felt in the choice of Presidents and Congresses and Judges. See RAILWAY ECONOMICS.

The new construction projects now being launched borrow a peculiar, though it may prove an ephemeral, interest from the coincidence that now the academic controversy which has raged for two decades over government regulation of railroad freight rates has suddenly transformed itself into an acutely real legislative issue. The spectacle of railroad presidents dividing their busy hours between signing orders for the construction of main lines and dictating apprehensive protests against destruction by confiscation would be amusing if the subject were a less important one. Apparently the possibility of plenary rate-making power in the hands of a Federal tribunal gives none of them a trembling heart. The country wants rate regulation, but still more does it want new railroads, efficient railroads, and prosperous railroads. See AMERICAN STREET RAILWAYS; TRACTION, ELECTRIC; RAILWAYS, ELEVATED; RAILWAYS, HIGH SPEED; SUBWAYS, ETC.

EDWARD S. FARROW,
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Railway Tariffs. The low cost of railway service as compared with other forms of land transportation constitutes the principal element in its superiority, and consequently the efficiency of this means of moving persons and property may be most simply and fully expressed in terms of railway tariff. The amount of the charge for any particular service is the product of a definite rate applicable between the points of origin and destination, or for the distance traversed, and to the commodity or class of passengers carried multiplied by the number of persons or the weight of the freight. Passenger and freight schedules showing the rates charged between all points reached and on all classes of traffic are published by every railway and large numbers of "joint" schedules are also necessary to inform the public as to the rates available over routes formed by two or more connecting railways. Rate schedules have been quite aptly defined as a device for getting back the very large aggregate expenditure necessary for producing this form of transportation in an enormous multitude of small and separate payments. Some appreciation of the truth of this can be obtained from railway statistics. The number of passengers carried by the steam railways of the United States during the 12 months which ended with 30 June 1902 was 649,878,505 and the number of tons of freight 1,200,315,787. The total service in carrying passengers was equivalent to moving 19,689,937,620 passengers one mile and the freight service to, moving 157,289,370,053 tons of freight the same distance. The average charge exacted per passenger was 60 cents, or at an average rate of 19.86 mills per mile traversed while the average charge per ton of freight carried was \$1.03 or at an average rate of 7.57 mills per mile. The delicacy of adjustment attained is apparent when it is realized that a difference of one mill per passenger and per ton of freight per mile would have amounted to \$176,979,308 or 12.57 per cent more than the amount of all railway dividends paid during the year.

Passengers are classified for rate-making purposes according to the quantity of transportation which they purchase and the relation which their travel bears to the development of the territory and traffic tributary to the carrying line. Thus suburban passenger traffic is treated with especial liberality and accorded very low rates because populous and prosperous suburbs contribute profitably to both the passenger and the freight traffic of the lines along which they exist. Suburban passengers are also to be regarded as wholesale and permanent purchasers of transportation and are entitled to special consideration on that account. Similar reasons justify lower rates for commercial travelers and to persons seeking homes in newly opened terri-

YEAR	The United States	Boston & Maine	New York Central & Hudson River	Pennsylvania R.R.	Lake Shore & Michigan Southern	Pittsburg, Fort Wayne & Chicago	Illinois Central	Louisville & Nashville	Chicago, Rock Island & Pacific	Chicago, Milwaukee & Saint Paul	Southern Ry.	Union Pacific
1872	2.521	1.704	1.863	2.379	2.321	....	3.034	3.240	3.229	3.404	3.155	3.730
1877	2.458	1.917	1.953	2.185	2.182	2.192	2.942	3.167	2.772	2.994	3.397	3.140
1882	2.391	1.951	1.808	2.249	2.156	2.024	2.388	2.706	2.505	2.579	2.811	3.300
1887	2.245	1.825	1.989	2.125	2.260	2.255	2.268	2.394	2.328	2.538	....	2.301
1892	2.126	1.809	1.887	2.028	2.183	2.000	2.101	2.448	2.308	2.464	2.682	2.104
1897	2.022	1.764	1.842	1.958	2.108	2.020	1.979	2.254	2.153	2.289	2.372	2.101
1902	1.986	1.764	1.723	1.999	1.828	2.040	1.999	2.319	2.135	2.317	2.244	2.007

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tory. The wholesale principle alone accounts for lower charges for parties of two or more, return trip tickets, and for especially long distances. It is also desirable to recognize the degree of elasticity, as to the volume of traffic supplied, of different groups of actual or potential patrons. Those who would not travel at all at the ordinary rates may be induced to travel in large numbers to conventions, etc., if quite low rates are made available for those purposes. Railways can often make these rates with profit to themselves and to their regular patrons provided they can do so without unduly interfering with their ordinary revenue. It is because the ticket-broker or "scalper" interferes with the effort to keep the different classes of travel separate, for rate-making purposes, that his existence renders railway officers reluctant to grant otherwise desirable concessions to special traffic. The profits of these dealers are really commissions for fraudulently transferring passengers from the classes in which they legitimately belong to other classes the members of which are entitled to lower rates; a practice whose possibility obviously tends to restrict the number of low rates offered to the public.

In general, regular, one-way passenger rates over any railway are proportional to the mileage traveled, although differences are made by great systems traversing regions widely varying in respect to density of population and other traffic conditions, and there is a natural tendency toward lowering the average per mile as the distance increases. Excursion rates, commutation, and other special tickets are usually, but not always, sold at rates based in some way upon the single one-way fares. It is commonly known that there has been a very notable and substantially continuous decline in American railway freight rates but the general belief is that there has been no similar movement in passenger rates. As a matter of fact the quality of passenger service is now much higher than it was 30 years ago and little if any real comparison is practicable among rates applying between the same points during different decades. It is worth noting that while passenger charges have either declined or remained stationary the cost of nearly every other incident of travel has advanced. Thus the rate for a single trip between Boston and New York is the same now as during the year in which the Astor House, then the finest hotel in America, was opened, but the standard rate per diem for room and meals at the Astor House was only \$2.50 or precisely the figure which is now the minimum price of a room alone at the first-class hotels of New York. Yet no one will deny that the difference in comfort between the hotel of 1848 and that of 1904 is far less than that which separates the passenger journey of the earlier from that of the later year. In 1848 a trip from New York to Philadelphia took five hours and cost \$4.00; it is now made in two hours and costs \$2.50. The rate from Philadelphia to Baltimore has decreased from \$3.00 to \$2.80 in the same period and the time from six hours to two. The table on the preceding page shows the average receipts in cents and decimals of a cent per passenger mile during the different years indicated for the United States and for several important railways, those for the years during which gold was at a premium having been reduced to their equivalents in gold.

The average in the foregoing for the United States in 1872 represents 44.16 per cent of the mileage then existing in this country, that for 1877 represents 66.77 per cent, that for 1882, 75.27 per cent, and that for 1887, 75.35 per cent. For later years substantially all the railway mileage of the country is represented. If the omitted mileage could be included for the earlier years, it would undoubtedly raise the averages materially.

Freight is also classified for rate-making purposes, although the commodities which move in the greatest volume like grain, coal, ore, cotton, lumber, etc., are usually excluded from the classifications applicable in the regions in which they move most freely and given "special commodity" rates. Owing to the stress of competition partly that among lines of railway connecting the same points of origin with the same destinations, but much more that among the many and often widely separated routes of transportation, water as well as rail, that are allied to different producing regions whose products find entrance to the same or competing markets freight rates are much less likely than passenger rates to be proportioned to the distances traversed or to conform to any arbitrary rule of adjustment. This is especially true of the rates on the great staple articles of commerce to which special commodity rates are commonly applied. For a great many years, however, there have been certain well-established rules of rate-making which have governed nearly all charges within the regions to which they are applied. Thus substantially all through traffic in the regions north of the Ohio and Potomac rivers and east of the Mississippi River, if it crosses, going either to the eastward or to the westward, a line beginning at Toronto and drawn southward through Buffalo, Erie, Pittsburg, Wheeling and Parkersburg to Huntington, W. Va., is charged for at rates derived from the contemporaneous rates on similar traffic shipped between New York and Chicago. This is attained by fixing certain arbitrary differentials which are to be added to or subtracted from the rates to or from New York if the business is destined to or comes from other important cities east of the Alleghany Mountains, by grouping the smaller towns and cities in this region with the larger ones at the same rates and by assigning certain percentages of the Chicago-New York rates to all stations west of the Alleghanies. Thus if the rate on grain from Chicago to New York is 20 cents per 100 pounds, the rate to Philadelphia will be two cents lower or 18 cents and that to Baltimore 17 cents. The same differentials would be used no matter how high or low the grain rate to New York might go. If it should be 25 cents the Philadelphia rate would be 23 and the Baltimore rate 22; if 15, Philadelphia would have a rate of 13 cents and Baltimore one of 12 cents. If a shipment originates at Indianapolis and is destined to New York the rate charged is 93 per cent of the rate which would have been applied had it originated at Chicago. On a shipment from Cincinnati to New York 87 per cent of the Chicago-New York rate is charged, on one from Cleveland, 71 per cent, on one from Detroit 78 per cent, on one from Peoria 110 per cent, and on one from East Saint Louis 116 per cent. Every railway station in this terri-

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tory has assigned to it a particular percentage. When business originating at a percentage point is destined to some other city, east of the western trunk line termini, than New York, the customary differential is applied to the proper percentage of the Chicago to New York rate. Nearly all rates on traffic to or from points west of the Mississippi River are made by adding to the percentage a point on the east bank of the river the percentage rates from thence to destination. Sometimes, however, the combinations are based upon Chicago or some other percentage point not on the river.

In the territory east of the Mississippi River and south of the Ohio and Potomac Rivers rates are generally made upon the "basing point" system. According to this system certain prominent cities, Atlanta, Augusta, Montgomery, Birmingham, Macon, and others are selected and given relatively low through rates. The carriers contend that these selections are not arbitrarily made, but that they are based upon the competition of rival transportation routes, and commercial conditions of controlling force. In making rates from or to points not designated as basing points the local rates from a basing point to the destination of the traffic are combined with those to the basing point. It is the practice invariably to allow the lowest possible combination on any basing point even though the traffic may not pass through that point. As an example of this method of rate-making the rates to Montgomery and Calhoun, Ala., may be cited. The rate from New York to Montgomery on articles classified as first-class in the Southern classification of freight is \$1.14 per 100 pounds, Montgomery being a basing point. The first-class rate from Montgomery to Calhoun is 26 cents per 100 weight and the rate from New York to Calhoun is the sum of these rates or \$1.40. The same system is commonly applied even though the destination is nearer the point of origin than the basing point but along a few lines the practice has been abandoned and the rates to the basing points made the maximum while in others the amounts added are arbitraries somewhat lower than the full local rates.

The classification of freight constitutes an important feature of rate-making. Three great classifications are in use throughout the country, while a few roads still maintain their own local classifications and a few state railway commissions impose their own ideas of classification upon the railway traffic over which they have jurisdiction. The Official Classification is applied to nearly all traffic, except that accorded special commodity rates, in the region generally described as east of Lake Michigan, Chicago, and the Mississippi River and north of the Ohio and Potomac rivers. The excepted traffic is that wholly within the State of Illinois where there is a classification promulgated and enforced by the State Railroad and Warehouse Commission and between certain points served by the Boston and Maine Railway. It is also applied to the local traffic of the Chesapeake and Ohio and the Norfolk and Western railways and to certain of the through business exchanged by these companies with their northern connections. The Southern Classification applies generally in the territory south of the Ohio and Potomac rivers and east of the Mississippi

River, but many of the railways in this region have their own classifications for local business and the States of North Carolina, Florida, and Georgia have imposed classifications made by legislative authority upon the local business within their several boundaries. The Western Classification applies west of Lake Michigan, Chicago, and the Mississippi River and to all classified traffic to and from the Pacific Coast. There is, however, a state commissioners' classification in Iowa and most of the traffic exchanged with the Pacific Coast is moved on special commodity rates. Each of these classifications has resulted from the consolidation of a large number of earlier classifications the separate existence of which formerly added greatly to the complexity of the railway rate situation in their respective territories. Further consolidation has been advocated and to the superficial view seems in the direction of simplicity, but those fairly cognizant of the diversity of the commercial and traffic conditions respectively governing in the three great divisions of the country covered by the separate classifications now in use are inclined to doubt the wisdom of attempting unduly to hasten the natural trend toward uniformity. The Official Classification has nominally six, but actually eight classes, the Southern has 15 and the Western 10. Each of these classifications provides different ratings for many of the commodities which it includes, according to whether they are shipped in car load quantities or in smaller volume and in all of them the same articles are often accorded different treatment when differently packed or otherwise prepared for shipment. The following table presents interesting data concerning these classifications.

NAME OF CLASSIFICATION	Number of items in-cl'd	Items rated regardless of quantity shipped		Items given different ratings for carload and less than carload shipments		Items rated for carload shipments only	
		Number	Per cent of total	Number	Per cent of total	Number	Per cent of total
Official	9370	1722	18.37	7492	79.96	156	1.67
Southern	3664	1260	34.39	2332	63.65	72	1.96
Western	8044	2366	29.41	5336	66.34	342	4.25

Discriminations in favor of shipments in car load quantities are eminently just and proper as such shipments are much more economically handled than those in less than carload quantities and their increase means the more effective utilization of the transportation facilities which are available. That there is a tendency toward increasing the number of these discriminations may be seen from the following statement which show the number of items in each classification and the numbers with regard to which such differences were made, for the years 1887 and 1902.

It should be understood that the increase in the number of items classified does not so much indicate an increasing complexity and diversifi-

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RATES EASTWARD, CHICAGO TO NEW YORK.

JANUARY 1ST	Flour	Wheat	Corn	Live cattle	Dressed beef	Live hogs	Dressed hogs in refrigerator cars
1867*.....	90	90	90	..	..	..	..
1872*.....	65	65	65	..	..	..	..
1877*.....	30	30	30	..	65	..	..
1882.....	20	20	20	25	40	25	..
1887.....	30	30	30	36	65	35	..
1892.....	25	25	25	28	45	30	..
1897.....	20	20	20	28	45	30	..
1902.....	17½	16½	16½	28	45	30	..

* Rates for these years are expressed in currency.
† For export; if for domestic consumption, 17½.

‡ For export; if for domestic consumption, 17.

cation of freight traffic, although it represents some growth in that direction, as it does a more complete recognition of the importance to the carriers, and through them to the public, of securing those forms of preparation for shipment which are most convenient in handling. Proper preparation is encouraged by discriminations in the classification which accord more favorable ratings to the same articles when they are packed in the most convenient form than when less desirably prepared.

NAME OF CLASSIFICATION	Number of items		Items given different ratings for shipments in carload and in less than carload quantities			
			1887		1902	
	1887	1902	Number	Per cent of total	Number	Per cent of total
Official	2840	9370	1101	35.60	7492	79.96
Southern	1177	3664	175	14.87	2332	63.65
Western	1672	8044	666	39.83	5336	66.34

Freight rates in the United States have shown a decided and continuous downward tendency and even during the recent years of high prices and corresponding decline in the value of the medium in which charges are paid there has been but little interruption of this tendency. The most important of all changes are those affecting the rates between New York and Chicago because of their use as the basis of other rates, which has been explained, and their relation to the export trade of the country. The following statement shows comparisons between the average rates, in cents per 100 pounds, collected on shipments of the articles named from Chicago to New York in 1867 and in 1902:

COMPARISON OF AVERAGE RECEIPTS PER TON PER MILE.

YEAR	The United States	Boston & Maine	New York Central & Hudson River	Pennsylvania R.R.	Lake Shore & Michigan Southern	Pittsburg, Fort Wayne & Chicago	Illinois Central	Louisville & Nashville	Chicago Rock Island & Pacific	Chicago, Milwaukee & Saint Paul	Southern Ry.	Union Pacific
1872* ..	1.846	3.491	1.422	1.304	1.227	1.264	1.923	2.053	2.229	2.177	4.429	2.390
1877* ..	1.286	2.183	.954	.954	.813	1.024	1.719	1.382	1.949	1.949	2.747	2.135
1882* ..	1.102	2.405	.738	.874	.628	.752	1.417	1.349	1.281	1.481	1.950	2.102
1887 ..	.984	2.217	.782	.730	.670	.717	1.087	1.075	1.012	1.089	1.920	2.113
1892 ..	.898	1.508	.699	.647	.602	.670	.908	.948	1.055	1.026	1.355	1.081
1897 ..	.798	1.450	.679	.561	.538	.600	.671	.791	.958	1.008	.976	.962
1902 ..	.757	1.119	.632	.590	.503	.610	.622	.744	1.034	.840	.931	.979

*In gold.

COMMODITY	In less than carload quantities		In carload quantities	
	1867	1902	1867	1902
Dry goods	137	75	137	75
Cotton piece goods	137	57	137	57
Boots and shoes ..	137	75	137	75
Tea	137	75	137	75
Drugs	137	75	137	75
Furniture	137	75	137	65
Agricultural implements	137	57	137	30
Lead	60	25	60	25
Bagging	117	50	117	35
Crockery and earthenware ..	117	42	117	30
Coffee	117	42	117	25
Starch	117	42	117	25
Sugar	60	39	60	25
Molasses	60	35	60	30
Rice	60	35	60	25

Rates eastward, from Chicago to New York are of similar significance and importance, but while the greater portion of westward traffic is classified the larger part in bulk and value of that moving eastward is carried at special commodity rates. The statement above shows some of the more important, the rates being in cents per 100 pounds and applicable to carload shipments only.

A more complete presentation of the history of railway rates than is practicable here would show reductions in the case of nearly every locality and article of traffic. In the absence of such a presentation the nearest possible approximation to an accurate measure of the downward tendency is to be attained through comparisons of the average receipts per ton per mile. Such comparisons, the averages being expressed in cents and decimals of a cent, appear in the statement below.

The averages for the United States in the foregoing represent 48.27 per cent of the railway mileage of the country for 1872; 60.10 per cent for 1877; 75.41 per cent for 1882; 75.73 per cent for 1887 and substantially the entire mileage

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for the later years. If the averages of the earlier years could be made to represent all the mileage of those years, they would be higher.

H. T. NEWCOMB,
Author of 'Railway Economics.'

Railway Traffic. The amount of traffic that can be handled over a railroad has been greatly increased by the use of the telegraph and telephone for dispatching trains, by the adoption of electric and other highly improved signals, and by the possibility of running both passenger and freight trains at higher speeds as the result of having more powerful locomotives and power-brakes operated from the engines. The vast improvements in travel and traffic have resulted quite as much from the progressive adoption of the vehicle to the service to be performed, as from betterments in the road-bed and locomotive.

No matter what the resources of a country may be, the transportation problem is always vital, because without proper transportation facilities markets cannot be made or maintained. The buyer is always anxious for the early receipts of his freights, and countries prosper in proportion to the time saved on freights transported, because time saved means a reduction in expense in the interest account. The railroad must accept lading when accompanied by proper billing instructions, and by law is obligated to transport it in a reasonable manner, giving reasonable service between initial point and final destination, said service to be in accord with the contract, it being additionally recognized that every allowance made in the freight rate is an allowance made in the obligation of the railroad for service, and that reasonable service cannot be rated the same on commodity freights as it is on freights of the higher classes. The entire organization of a railroad is to the end of the movement of the individual car, and every expense is in relation to the earning capacity of the car.

Sources of Revenue.—Steam railroads derive their principal source of revenue from hauling freight. In 1905 the receipts of the Pennsylvania Railroad Company from freight traffic were \$100,093,828, while the receipts from passenger traffic were but \$27,392,393. This result was accomplished although the gross receipts for hauling the average freight train for a mile were \$2.996 at a cost of \$2.11, making the net profit about 88 cents. In view of the tendency now to electrify railroads in order that the passenger traffic may be handled with greater speed, with more frequent service of cars and possibly with more safety, and the tendency also in some States to cause a reduction in passenger fares, it becomes a question whether in a few years the passenger business will not be entirely separated from that of carrying freight, at least so far as it may be divorced without endangering charter rights.

Cars.—The use of private cars at the present time may be divided into two general classes, those in which the property of the owner of the cars is transported, and those in case of which the owner is not interested in the contents of the car. In the first case the shipper owns the car, and the car is ordinarily only used for the carriage of the property of the owner. In the second class the cars are usually owned by some

private car company, which constructs or purchases the car, keeps it in repair, and leases it to the railroad company. The use of the private car originated in the necessity for special equipment to serve a particular purpose. Live stock, for example, is transported over long distances. In the course of such transportation the animal shrinks in weight and deteriorates in selling quality, besides suffering from want of water, and from crowding and trampling. Hence, the dictates of both interest and humanity require that the animal should be transported as comfortably as possible. And this has led to attempts to devise a car in which stock could be fed, watered, and carried without injury. When the inventor of such a car has in the past approached the railroad manager with his invention, he has generally been informed that the railroad had no money with which to experiment, but that if this car when constructed and ready for use would fulfill his representations the railroad would be glad to hire it for a fair rental. This has brought about the organization of a number of companies for the construction and operation of stock cars. The same thing has been true of the refrigerator car. When the necessity for such a car first became evident, various designs were brought forward. Here again railroad managers were reluctant to invest their money in what was largely in the nature of an experiment. The result was that these cars came to be constructed by private companies, which leased the cars to the railroads in the same manner that the stock cars were provided.

Prior to the advent of the steel car, the greatest maximum capacity of a car occupying 30 feet of track was 60,000 pounds, and the weight of this car was approximately 40,000 pounds, so the percentage of live load to dead weight was as 1½ to 1, or of the total weight of a train 60 per cent. was paying load and 40 per cent. dead weight. With the steel car it is possible to load 100,000 pounds, or 50 tons, on a car weighing 38,000 pounds, or 19 tons, which increases the proportion of paying load to dead weight to 2½ to 1, or to approximately 75 per cent. of total weight. Nor is the increase in percentage of weight per car the only benefit derived from the increased capacity. The 50-ton car occupies no more space upon the track than the 30-ton car, so the actual capacity of sidings and track room is almost double. Naturally, an increase in weight of rails and increase in hauling capacity of locomotives follows the increased tonnage capacity of the cars. The train load is increased not only by increasing the capacity of the cars, but by diminishing the number of empty cars hauled and by endeavoring to load all cars to their full capacity.

The large capacity car, both coal and box, reduce the cost of operation if properly handled, but so long as light, bulky commodities are shipped, just so long will there be a difference in drawbar-pull on light and heavy cars to contend with even when all cars are of uniform large capacity, and the method of basing on average performance will be as far as ever from securing the proper results, and so long as trains will be made up with light loads at the head end, and heavy loads at the rear, no average plan can make provision for drawbar-pull in such cases, and no proper adjustment can be made

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unless this factor is taken into consideration. The matter of adjusting the drawbar-pull of each gross of car at each individual location in a train is made feasible and practicable by the aid of a mechanical device, hence it is not a theory but a condition that must be met, and one that the mechanical and operating departments must join hands in overcoming.

At the present time there is a noticeable tendency toward uniformity in couplers and uncoupling attachments and an increase in their strength. The different makes of couplers used are rapidly decreasing in number, the new cars turn out being equipped with one or another of four or five standard makes. These new couplers are generally stronger than the old ones, and this improvement in the strength of couplers has reduced the number of defects. Grab irons are receiving much better attention than formerly and it is now the exception to find cars unequipped with these important safety devices. Loose and bent grab irons are much less frequently found in service, and the practice of using uncoupling levers in lieu of grab irons is also being discontinued.

Operating Expenses.—From the close of the American Civil War to the present time, industrial changes have been more rapid in the United States than anywhere else in the world. Within this period the railway system has grown from 35,000 miles to 217,000 miles; population has more than doubled; wealth has increased more than fourfold; populous cities and sovereign States have grown up where at the beginning was nothing but wilderness. Progress of similar character is going on to-day with undiminished activity. Railways have met this progress by constant adjustments of and reductions in the charges for their services. In 1899 it cost \$85,608.99 to operate the railways of the United States; in 1903 the same expenses amounted to \$1,257,538.862, an increase of \$400,569,863. In 1899 railway labor, exclusive of salaried employes, received \$481,264,109; in 1903 the same classes of labor received \$720,580,923, an increase of \$239,316,814. In 1899 the fuel used by locomotives cost \$77,187,344; in 1903 it cost \$146,509,031, an increase of \$69,321,687. Comparing operating expenses with work done, it appears that in 1899 for every dollar expended for operation the railways were able to carry 17 passengers and 165 tons of freight one mile. In 1903 the passenger mileage for each dollar expended in operation amounted to 16.6 and the freight mileage to 138. Each \$1 of operating expenses in 1899 brought in \$1.53 in revenue, not including that from miscellaneous services, while each dollar of operating expenses in 1903 brought in only \$1.38 in revenue.

Low Rates.—The low rates made by American railroads are the surprise and wonder of foreign railroad men, averaging not more than one-third to one-half of the rates for similar services in other countries under government control and ownership. The foreign railroad officials who have studied this subject here credit these low rates to the sharp, intense competition between railroads having individual liberty of action and desire to build up new territories, forcing the managers and heads of departments to an intensity of research, investigation, and development of economies in cost of service unheard of in countries where the rail-

roads are owned or controlled by the government.

Passenger Service.—The service of transporting passengers differs in many particulars from the freight service. Goods are shipped, while passengers travel of their own volition, controlling the time and direction of their movements. One important difference between these branches of the service is that most freight is moved in carloads or trainloads, the start being made when the car or train is loaded, while the passenger business is performed by trains that run on fixed schedules. Some commodities, like milk and fruit, are despatched by trains which run strictly according to schedule, and the collection and distribution of the traffic at the local centres of production or consumption are usually accomplished by *way-freight* trains which have a definite time of arrival and departure. Whether viewed from the standpoint of public benefit or considered with regard to the volume of business done, and profits received by the company, the transportation of freight is the most important service performed by the railroad. As an illustration, showing the percentage of freight earnings, the gross earnings of American railways for the year ending 30th June 1905 were \$2,073,177,325. This total comprised earnings from the passenger service amounting to \$572,109,366, or 27.60 per cent.; earnings from the freight service amounting to \$1,490,827,020, or 69.90 per cent. and other miscellaneous earnings amounting to \$51,885,257, or 2.50 per cent.

The passenger service, to a far greater degree than is required in the freight business, must provide for speed, safety, comfort, and convenience. The development of the Pennsylvania Limited is typical of the strides which have taken place with regard to long distance passenger traffic. When first established it left New York 7.55 A.M. and arrived Chicago 9.40 A.M., making the run in 26 hours, 45 minutes. It now leaves New York 10.55 A.M. and arrives Chicago 8.55 A.M., making the run in 22 hours, 50 minutes. Returning, it leaves Chicago 5.30 P.M., making the run in 23 hours. Changes in service accompanied improvements in speed. The Pennsylvania Limited is famous as the first train in the world to afford all the comforts of the home and conveniences of the club. It was also the first train to be vestibuled from end to end. In addition to a high-grade equipment, built especially for this train by the Pullman Company, the train makes special features of its stock quotation service, the barber, bathroom, stenographer, and ladies' maid, which it was the first to provide for the convenience and comfort of patrons.

The service of the Twentieth Century Limited, which is the eighteen-hour train of the New York Central Lines between New York and Chicago, was inaugurated 15 June 1902. Its superior equipment and the splendid physical condition of the roadbed and tracks over which it glides enable its fast time to be made with perfect ease and comfort. During the Columbian Exposition at Chicago in 1893 the New York Central Lines inaugurated the first 20-hour service between Chicago and New York, and from May to November in that year the "Exposition Flyer" maintained its schedule with great exactness. In 1902 the management of

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this great system of roads, recognizing the nature of the demand for fast service between the two leading commercial centres of the country, evolved the Twentieth Century Limited, which maintained the 20-hour schedule every day in the year. The great success of this train has made it world-famous. Its ability to furnish stenographer, telephone, and telegraph facilities, enabling the transaction of business on the journey, has made it very popular. In response to the numerous demands from its patrons the running time was reduced two hours in June, 1905, making its daily journey of 963 miles in 18 hours, a remarkable achievement. This is a greater number of miles at a higher speed than is run by any other train in the world.

Growth.—The growth of the present railway system of the United States has been little short of marvellous. It was not until 1835 that it reached as much as 1,000 miles, being 1,098 miles in that year. Note the growth since then:

1850	9,021
1860	30,026
1865	35,085
1875	70,096
1885	128,320
1895	181,115
1905	217,328

There are two very striking facts to note here: First, that in spite of the Civil War, 5,059 miles of railway were built during that unhappy period; second, that in the 10 years following, our railway mileage was doubled.

During the latest year for which statistics are available, the railways of the United States carried, as compared with 1885:

	1885.	1904.
Freight, tons	437,000,000	1,300,000,000
Passengers	351,000,000	720,000,000

Reckoning our population at 80,000,000 in 1904, it is as if every man, woman, and child in the country made nine steam railway trips during the course of that year, and also moved 16¼ pounds of freight.

The reduction since 1865 of railway freight rates in the United States is also remarkable, as illustrated by the fact that wheat by lake and rail has fallen from 29 cents to 5 cents; by railway only from 46 cents to 11 cents.

HUGH T. DOWNING,
Mechanical Engineer, New York.

Railway Train Dispatching and Train Handling. The dispatching and handling of trains successfully to meet the demand upon railroads in handling a through passenger service, suburban traffic, freight traffic, U. S. mail, to obtain traffic against competition, and moving such traffic cheaply, promptly, and safely, is an important field of railway operation, and makes great demands upon the operating official.

The engineering department has performed its part in building bridges, laying heavier rail, making stronger track and better roadbed, installing interlocking plants and block signaling, and providing for heavy engines.

The mechanical department has met the re-

quirements in designing large engines of greater power, enabling heavier trains to be handled at greater speed. It would thus seem that the engineering and mechanical departments have reached the limit of their expansion on the lines mentioned. See RAILWAY CONSTRUCTION; RAILWAY HEAVY FREIGHT TRAINS; RAILWAY TRAFFIC.

This brings the situation to the operating official, putting in his hands the opportunity and responsibility of getting the very best results from the facilities and equipment at his command. The handling of through passenger trains requires that the trains should have assigned an engine capable of making the schedule with 20 per cent reserve power, thus being able to overcome unexpected delays. As few stops as possible should be scheduled for such trains. If traffic is sufficient, at intermediate points a local train should be run ahead of the through train to carry passengers to a point where these stops are made so passengers can have the opportunity of taking the through trains. Express and mail should be handled on through locals and mail trains provided for such service. If the scheduled trains should at times require more cars than the regular assigned train, instead of adding cars another engine should be provided, or better still, run a second section, loading the first section with all passengers to final destination of train of the initial road, and have the second section do the local work, not letting the first detain the second, thus saving delay also to first section. The public in the territory the through train covers is entitled to have the train on time. This can be accomplished not by sacrificing train schedule to connections, but if necessary by running the train from initial point on time for the passengers on the road served and a second train for the connection. This is not now generally the practice, but the time is quickly coming when this will have to be done by many more roads. Many through trains, specially on single-track roads, are badly detained by the issuing of too many train orders, sometimes giving an engineman eight or ten orders at a station. For enginemen and conductors to understand these orders 12 minutes or more is consumed, and the engineman is handicapped because he is fearful of overlooking an order. If the train is not overloaded and ample power has been provided, it would be much better, if the train is not to exceed 30 minutes late, to give no restrictions by placing orders in favor of freight trains. The engineman would be freer to devote his time to making a good run, and would most likely make up time, and the general movement of the freight trains would be better. The passenger trains should be kept on time and the freight trains will make good runs if they have the proper power and are not overloaded, getting out of stations promptly, and taking advantage of every minute. Freight train employees should be educated to the necessity of giving passenger trains the proper clearance, and that in stormy or foggy weather they cannot make as good a run ahead of or against passenger trains. If they will observe these conditions they will keep out of the way, not only preventing delays but avoiding the possibility of not properly protecting their train. Short time on passenger trains, especially on a road without block signals, has caused serious head-on

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and rear-end collisions. When excursion trains are run they should be handled with the same promptness, not given any more cars than can be well handled and make a good run, because usually a large number of passengers are taken on at stations. With a long train there is greater delay, passengers are more liable to injury, and the train is in danger. A cheap passenger rate sometimes leads to the handling of too many people at the risk of accident; better run more trains with less cars or not give excursion rates at all. Women and children are generally handled on such trains, thus making the risk greater. Some of the most serious accidents on American railroads have been to excursion trains; sometimes because they are run as sections of a regular train that has not had sections run, and sometimes because the trains were too long and the power furnished poor. The number of trainmen should be increased on excursion trains.

Suburban Trains.—The movement of population in the large cities is constantly toward the towns and villages situated on railroads adjacent thereto. The public consult timetables of different roads, and conclude to locate in such suburban places because the train schedule enables them to go to their business and return home at a certain time. They expect to use certain trains. This being the case timetables should not be changed, otherwise the public will be greatly discommoded unless given other service that will answer their purpose or improve the conditions. Most suburban roads have suburban territory covering zones of 7, 13, 20, and 30 miles. Where a road runs 200 or more trains per day and carries 50,000 passengers per day (as a rule the greatest percentage is handled from 7 to 9 A.M., 5 to 7 P.M.), three or four tracks should be provided, two for express and two for local trains. Usually 70 to 80 per cent of the passengers carried are in the 13-mile zone. As the heavy movement in the morning is toward the city, yards and engine-houses should be provided to hold a large number of coaches and engines at the 13 and 30-mile zones. Small yard and turntable should be provided at the 20-mile zone, where engines can be turned, saving the running of trains a greater distance than the requirements. Where only two tracks are provided the entire distance, and a third track provided three or four miles long (between zones 20 and 13), trains should be run leaving all zones early enough for the early workers; trains leaving 30-mile zone making all stops up to the 20-mile zone, and then express trains from there, or making alternate stops at a few points between zone 20 and destination. Trains should be started from zone 20 making all stops to zone 13, and express from there, or making only two or three alternate stops from zone 13 to destination.

The percentage of passengers moved between zones 13 and 30 being smaller, to save hauling cars not needed beyond zone 13, a coach track should be provided, connected with steam heat in winter, and trains that have left zones 30 and 20 requiring more coaches to pick up passengers where they make stops between zone 13 and destination can do so. The greater movement being from zone 13, instead of having all trains leaving zone 13 make all stops, have first train

out make second station stops and next train first station stops, alternating stops from zone 13 to destination; or jump three or four stations into destination. This arrangement to be carried out during the rush hours, thus shortening the time and running semi-express trains.

By having the third track, trains can be started from zone 13 toward destination, and held at end of third track, thus running express trains around the local trains. Trains may have to be scheduled from zone 13, following express trains that make no stops from zone 13 to destination. While a branch road may branch off, say at zone 20, a few through trains should be run solid on the branch where business will warrant it. When trains are not run through on branch, cars should be attached to trains going to zones 20 or 30, and an engine attached at zone 20, thus saving transfer of passengers or baggage. As many people besides passengers going to their business have baggage it is necessary that a combination baggage car should be provided for each train. Express business should not be handled in the rush hours, except in solid carloads, requiring no work where trains stop. An occasional count should be made of the number of passengers that get on at each station; this will show if the trains as scheduled for stops are serving the people properly. The movement of passengers going to the city may then be controlled, because they come to the trains that are scheduled to stop. A schedule to suit all may not be made, but if the greatest number are taken care of satisfactorily that seems to be the fair way of concluding the service is right.

The roads located in New Jersey that have to make connection with boats have harder conditions to meet than if the destination of the passengers ended on the Jersey shore. Two and three trains are scheduled for a boat; this being the case the boats are scheduled for certain trains and the train schedule must be made or passengers will not reach their destination on time.

The movement of passengers from city to home is more complicated to handle than the movement coming in, because the number of passengers for any train is unknown, when you are hauling heavy trains. This can be overcome usually by having extra cars set on rear of train at starting point, kept locked and used only when necessary. When you have reached the limit of the number of cars you can handle in a train two or three trains can be scheduled same leaving time, scheduling first train to make first stop, 20 miles out, and all stops between zones 20 and 30. Second train making first stop 10 miles out and local stops to 13-mile zone. Third train first stop 7 miles out and all stops from there to 13-mile zone. This keeps the trains separated. Where four trains are run on same schedule, first train goes to 20-mile zone and the three trains following alternate stops to destination so that they are kept out of each other's way. A record of this movement should be made occasionally showing where the passengers get off, and this will show how well the public are being served in the homeward movement.

The locomotives used in suburban service should be the very best, and have at least 20 per cent reserve power. Where trains are mak-

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ing several stops, handling coaches 65 and 70 feet over all, seven cars should be the limit. Ten cars might be handled in express, making a run of 20 miles without a stop; eight cars is better.

As the traffic becomes dense between zone 13 and city, this condition forces more trains from zone 13, and interferes with train movement from zones 20 and 30. To increase handling of passengers at an increased rate the territory from zones 30 and 20 should be handled by having four tracks, so that express trains can be run from zones 30 and 20 without making any intermediate stops between zone 20 and destination, making much quicker time, bringing the population nearer the city, and giving the public an opportunity of obtaining homes at nearby points, thus increasing the passenger haul and increasing earnings with same number of trains run from zones 30 and 20.

Freight traffic gains in proportion with the increase of passengers hauled. With the coming of trolley competition, the day seems to be not far away, wherever travel is dense, when the ideal timetable will schedule trains leaving initial points at 5, 10, or 15 minute intervals in the rush hours to zones 20 and 30, 3 and 5 minute headway to zones 7 and 13, and 20, 25, and 30 minute headway at other hours of the day to the 30-mile zone increasing the number of trains run as the traffic demands, virtually giving trolley or subway service.

Freight Train Handling. The handling of freight traffic has become a great factor in the railroad business and greatly affects the commercial world. The merchandise movement demands and obtains a regular schedule between our great cities and the Pacific coast. The Pacific is forwarding to the Atlantic fruits that require quick and regular movement. Dressed beef and live stock from the west to the Pacific and to the Atlantic is handled and landed at destination for domestic use and export with precise schedule. The manufacturer, builder, merchant, in fact all mercantile life depends upon the promptness of the handling of traffic, not only for the promotion of trade, but to get the best use of capital invested. Not only is quick traffic to and from the far west necessary, but also to the local points which the road may be serving. The through trains should be built up with cars destined to the points of the connecting line and points beyond, and sufficient trains run to accomplish this. No switching should be required at any intermediate point, changing engines at division points should only be necessary. Another train should run to move the merchandise to the local territory, arriving at destination by 7.00 A. M., serving a territory of 300 miles. A second train should be run serving a territory 400 miles out for second morning delivery. There should be a special train for the movement of coarse freight to the 400-mile point with cars for intermediate points, thus insuring the freight going through without being set out and delayed. If the freight at initial point is not received in time to go out on the day it is loaded, better time is made by holding it over until the next day than by sending it forward in extra trains. The handling of less than carload freight from the great cities has become so heavy that the merchant located 70 or 80 miles out buys with

the expectation of getting his freight the next morning. This is done by loading straight cars of less than carload freight for the different towns and villages, running pickup trains to move these cars to destination, and setting the car at freight house ready for delivery to consignee. This has other merits than making schedule time, it saves handling the freight, damage or loss. It also does away with many way freights, and those runs handling car lots and picking up small lots. The car equipment represents a large amount of capital invested, and the number of miles made by a car represents its earning power, it is therefore imperative that the empty cars be moved quickly to point where load can be obtained. This being the case a system is necessary in the building up of trains of empty cars, and this should be accomplished with trains going to the farthest point to save delay in transit. The kind of cars which are in most demand should be sent forward in solid trains, not only to insure prompt movement of trains, but to prevent road power being delayed doing switching. Where passenger train movement is frequent, freight trains running extra should not be started from a terminal too little distance ahead of passenger trains, but should follow them and save delay to power lying on siding, and avoid tiring out the train employees. The cars in way freight and pickup trains should be built up in station order. Where many industries are located and freight traffic locally is heavy, roustabout drills had better be worked covering certain territory, doing the switching for warehouses, team tracks and industries, lining up cars for pickup trains. Roustabout drill engines, when through for the day, can take cars to same yard they started from to be lined up for certain trains.

The telephone is a great auxiliary in the handling of trains if properly used. Locating telephones at blind sidings, at ends of long passing tracks, making communication between conductor and telegraph office, connecting up towers with telephone system so operators can be advised and trains dispatched through instruction from dispatcher to towerman, etc., are all means of saving valuable time and getting desirable results.

We have explained what seems to be the best system in lining up train service, where good power and facilities are furnished. We may have all these things, but if the proper attention is not given to following up the movement of trains the best results will not follow. The train dispatcher must keep in close touch with the situation, doing his part to see that a clear track is given to clear fast trains, watching closely the movement of the trains moving in suburban service. Where these trains are running on a close headway if a train should be disabled he must quickly and intelligently grasp the situation by arranging for the handling of the passengers in other trains. In other words, change the schedule to meet conditions. Fast freight trains can be aided by train dispatchers keeping inferior class trains advised where to side track. Complete system of reports are necessary, advising of all delays, and these reports must be carefully looked after, following every delay, bringing to the attention of the different departments, or to the employee at fault, their shortcomings, bearing in mind

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that as eternal vigilance is the price of liberty, so eternal vigilance is necessary on the part of the operating officer who expects to get good results.

C. H. KETCHAM,

Superintendent Lackawanna Railroad.

Railway Train Lighting. The expression, "train lighting system," as distinguished from "car lighting system," has come to be used to designate the various electrical systems for lighting steam railway trains. There is, perhaps, no good reason for the distinction, as the greater number of electrical systems are applied to single cars as units. The inventors of the newer methods seem to have had in mind the fact that steam operated trains, not electrically operated cars, were to be lighted. The steam train consists of a number of dependent parts, all going to make a unit. The electric train generally is made up of a number of units, each of which can be operated alone.

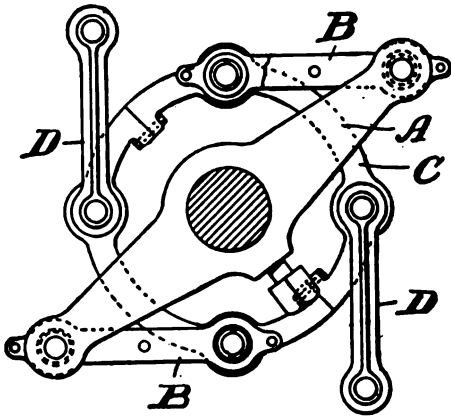


FIG. 1.—Method of driving the dynamo, Sperry-Lyndon train lighting system.

History.—In the early days of railways, candles played an important part in the lighting of the cars. This method was soon replaced by lamps burning various kinds of oil, kerosene being the only one whose use has persisted to the present day. About 1884 the need for better lighting of trains caused a number of railway companies and others to take up the study of the problem presented. As a result two distinctive systems came into use. In one compressed gas stored in tanks under the car is the illuminant. In the other so-called "air gas" is formed by forcing air through a carburetter containing naphtha, or a light hydrocarbon oil and the resulting gas is burned in suitable lamps. One system, belonging to the former class, made use of compressed illuminating gas, such as is used for city and house lighting, but this was not successful on account of the poorer illuminating quality of the gas as compared with oil or air gas.

Pintsch System.—The oil gas system, better known perhaps as the Pintsch system, uses an oil distilled from crude petroleum in suitable retorts. The gas after leaving the retorts is cleaned and compressed and stored in reservoirs, ready for charging the car tanks. Pipes leading from the reservoirs conduct the gas to the train shed and, by means of flexible hose, it

is passed into the car tanks. These usually hold several days' supply. The car equipment, in addition to the tanks, consists of a regulating valve for reducing the pressure to a point suitable for the burners, distributing pipes and regenerative burners, that is, burners which heat the gas before burning it, a treatment which increases its illuminating power.

Frost System.—The air-gas system, a type of which is the Frost system, came into use about the same time as the oil gas. In this the carburetter, a tank packed with some absorbent material such as asbestos wicking, is filled with naphtha or gasoline, and air, from the compressed air tanks connected with the air-brake system, is passed through. A reducing valve lowers the pressure to a point suitable for burning. In its passage through the carburetters, the air takes up the hydrocarbon vapor. The mixture is then led to the burner, passing through a heating coil on the way. This coil is placed above the burner and is heated by the latter.

Electricity.—A number of objections have been urged against all such systems of lighting cars. At times a disagreeable odor is given off. The lights can not easily be subdivided and placed so as to get the most effective distribution of light; the lighting is generally accomplished by means of several burners or groups of burners placed along the centre aisle of the car. Any system depending upon a highly inflammable material is a possible source of danger from fire. This is particularly true in case of accidents, the very time when it is most difficult to get away from the danger. Naturally, therefore, railway engineers turned to the electric incandescent system, as it is not only entirely free from all fire risks, but possesses a number of

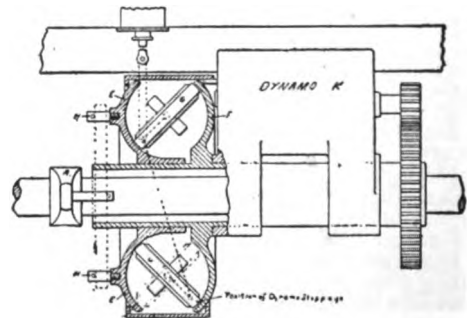


FIG. 2.—Transmitting mechanism, Sperry-Lyndon train lighting system.

distinct advantages over oil or gas systems. Thus, many small lamps may be arranged so as to give the best results, throwing the light just where it is needed. Compare the usual equipment of 80 incandescent lamps in a Pullman with the 6 or 8 gas lamps usually thought sufficient. The electric lamp gives a soft, white, steady light. There is no odor and no vitiation of the air. On the other hand, it has not been easy to adapt the incandescent electric lighting system to steam railway conditions. One of the first requirements is that the voltage at the lamps must be maintained constant and steady. Another is that the system must call for little attention from the train hands. It is also

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highly desirable that the cars be independent, so that they may be detached from the train without putting out the lights. In the first attempts to use the incandescent system on railway trains, storage batteries were placed on each car. A number of roads tried this, but the results were not entirely satisfactory, for while the advantages of the incandescent system were obtained, a number of serious disadvantages developed. The voltage of a storage battery varies considerably from full charge to discharge. Hence regulating lamp resistances were required. These were usually operated by hand. Cars equipped in this way could only run over routes where suitable charging facilities were to be had, and it was found that those responsible for charging the batteries often did not know the proper method of procedure, with the result that the cells deteriorated rapidly. Moreover, charging takes time, as a storage battery can not be filled up as one would fill a gas tank. The car was therefore laid up for several hours every day or two for charging. Some of these objections are not serious under certain conditions,

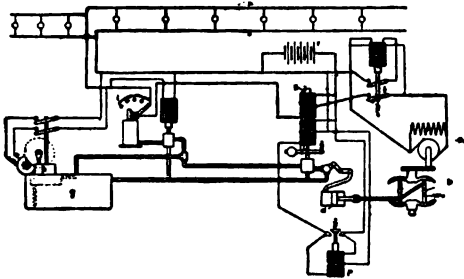


FIG. 3.—The complete system.

such, for instance, as that of a train which always runs over the same route and lies in the train yard several hours at the end of the run, but it is obvious that the storage battery system lacks flexibility and is not adaptable to all conditions of service, and it now seems to be only a question of time when all passenger cars will be lighted electrically.

The next advance in train lighting consisted in placing a small generating set in the baggage car. Steam was supplied from the locomotive, though an oil engine might be used. Wires were run throughout the train for the lights, and in addition, each car carried a small storage battery to supply the lights should a car be detached temporarily from the train. This system has given good service on certain through trains, but it is not flexible, as the train is the unit, not the cars, and there is some objection to putting the generating plant in the baggage car where it not only takes up space, but requires attention. While better than the simple storage battery equipment, because the batteries can be cared for properly and an improved service can be given, it does not meet the requirements for a completely automatic single car equipment.

Axle-light System.—This requirement for a completely automatic car equipment is met by the so-called "axle-light" systems. In general, these consist of (1) a small dynamo mounted on the car truck and driven by any means from the car axle. (2) a small storage battery to care for the lights while the dynamo is not in service,

(3) the usual wiring and lamps, and (4) several automatic devices for charging the battery and maintaining the voltage constant. The usual equipment for a Pullman car consists of a dynamo capable of delivering two and a half kilowatts at the lowest speed, at which it becomes operative, about 80 25-watt incandescent lamps, and a storage battery capable of running the lamps during any ordinary stop. There are a number of systems belonging to this class which have been patented. Certain of them are now (1904) on trial on various roads. The requirements of such a system are: The voltage across the lamps must be constant at all times. The batteries must be kept fully charged and all governing must be done automatically. The axle-light systems differ from each other in the method of controlling the voltage of the dynamo. Assuming the latter to be excited from the storage battery, the strength of the magnetic field will be practically constant, and hence the voltage, unless regulated, will vary directly with the speed of the car. The usual limits within which the dynamo must operate are 14 and 80 miles an hour. Fast trains not infrequently attain speeds of over 70 miles an hour for short times. Below 14 miles an hour the dynamo is cut out of service. The range, however, is nearly six times the lower speed. The methods of governing may be divided into two groups. Those in which the speed ratio of car axle to dynamo armature is kept constant, and those in which the speed of the dynamo is kept constant, independent of the car speed.

Taking up the former class, the dynamo may be driven by a belt, by gears or by a sprocket chain. If the first device is adopted, it is usual to swing the dynamo from the truck and provide a belt-tightening arrangement. Gears and sprocket chains should run in oil. The general operation of these systems starting with car at rest is about as follows: The lights are maintained by the battery until the minimum operating speed has been reached. At that point the voltage across the dynamo has risen to a higher point than that of the battery, and a switch actuated by a solenoid connected across the dynamo, closes the dynamo circuit. The dynamo then takes up the load, supplying the lights and charging the batteries. As the speed changes the dynamo excitation is changed in the opposite sense by an automatic device which may consist of a little motor-driven exciter or a field rheostat actuated by a solenoid, or any other mechanism which will serve the purpose. As the batteries become fully charged their voltage rises and they take less charging current. Since the dynamo must give a voltage higher than that of the batteries, its voltage is too high for the lamps and must be lowered by a resistance in the lamp circuit. This is variable and may be controlled automatically so as to care for all conditions of load. It also serves to regulate the voltage at the lamps during the discharge of the batteries. As the car must be able to run in either direction, the dynamo connections must be reversed with a change in direction of motion in order that it may be connected properly to the battery. This may be accomplished by a pole-changing device operated by the dynamo axle, which throws a switch one way or the other according to the direction of rotation.

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A simpler plan is to mount the brush-holder so that it may be shifted easily and to allow the friction of the brushes on the commutator to shift them through a suitable angle so as to keep one brush always positive.

In the second type of axle-light system the speed of the dynamo is maintained nearly constant by a variable speed drive. In one of the early systems of this type the change in driving rate was effected by allowing the belt to slip. In a later type a variable friction drive controlled by the voltage of the system changes the ratio so as to maintain the proper charging current for the batteries. In a well worked out system of this type, recently described, the work of operating the driving mechanism and the lamp resistance is performed by oil maintained under pressure by a small motor and controlled by a compound wound solenoid. In this system

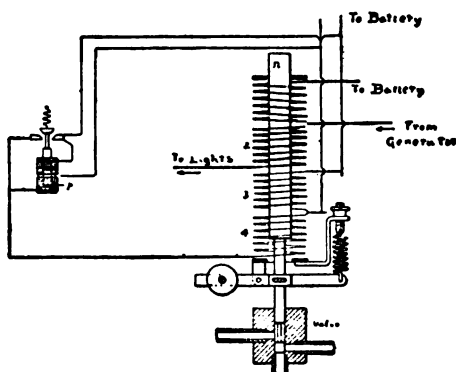


FIG. 4.—Solenoid and Auxiliary Switch, Sperry-Lyndon train lighting system.

the proper rate of battery charging is maintained, the dynamo goes out of service when the batteries are fully charged and no other work is being done and also should the speed of the car exceed 80 miles an hour. In systems belonging to this class a small high speed dynamo may be used, as its speed is nearly constant.

Axle-light systems should be entirely automatic and very durable. They are not likely to get much attention and that not of the best. They must be entirely reliable. Such systems are more costly to install than the gas systems, but they are far superior in the results obtained. Although the power required for operation is furnished by the locomotive it is comparatively small and is certainly less than that due to variation in the train resistance due, say, to a slight change in the lubricating oil. Some such system of train lighting will doubtless be adopted largely in the future, at least until the electrically operated train replaces the steam locomotive.

WM. HAND BROWNE, JR.,
Editor 'The Electrical Review.'

Railway Transportation. Railway transportation is concerned with the movement of persons and things. To accomplish this movement the railway companies have organized and developed their passenger, freight, mail, and express services. In carrying passengers and freight by rail the railway corporations supply the entire agency, but in the mail and express services they co-operate with the government and

the express companies for whom the railway companies act as carriers. Formerly, the through freight service was to a large extent carried on jointly by the railway companies and corporations called fast freight lines or despatch companies, much as the express business is now conducted; but the work of the auxiliary freight companies has been mostly taken over by the railway organization.

The Freight Service.—The transportation of freight is the most important service performed by the railways. The earnings derived from carrying freight are between three and four times the receipts from the passenger traffic. The dependence of society upon the cheap and unrestricted movements of commodities is much greater than upon rapid and inexpensive travel; because the extent of nearly all forms of industry is definitely circumscribed as regards materials and markets, by the length of the radii of economical transportation of commodities. To travel with comfort and speed is highly convenient, to ship freight long distances with economy and expedition is essential to modern business life.

During the year ending 30 June 1902 the railway companies in the United States reported a total tonnage of 1,200,315,787 tons. This is, however, double the amount of freight actually turned over to the railways by shippers, because much traffic is handled by two or more companies and is reported by each carrier. The tonnage actually received from shippers was 581,822,441. The average distance which each ton was moved was 268 miles; hence the number of tons carried one mile—the ton mileage—was 157,289,370,053. Over half of this enormous traffic, 52.36 per cent, consists of coal, iron ore, and other minerals. Manufactures make up somewhat more than one seventh of the tonnage; forest products furnish one ninth, and agricultural productions nearly one tenth. The remainder of the traffic, about one eighth of the total, comprises animal products, general merchandise, and miscellaneous unclassified commodities. These seven headings include between 9,000 and 10,000 kinds of commodities; and, as it would be utterly confusing to freight agents and shippers for the railways to have a separate charge for carrying each one of this great number of articles between each two termini in our vast country, the goods have been grouped into ten or eleven classes as a basis for fixing rates. The rates in the case of most articles vary according to length of haul, and weight and class of the commodity.

At the present time most freight is handled by one of three classifications: the "official" classification, which prevails east of the Mississippi River and north of the Ohio and Potomac; the "Southern," which is in force south of the Ohio and Potomac and east of the Mississippi, and the "Western," which applies west of the Mississippi. Some of the business between the Atlantic and Pacific sections of the United States is handled by the "Trans-continental" classification; and in several States the local, intra-state traffic is required to observe classifications promulgated by the State railway commissions. A single uniform classification for the entire country would be desirable if it were a possibility, because producers, manufacturers, merchants and other shippers could more accurately determine the transportation costs of

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getting commodities to or from the markets. This would facilitate trade, and would, also, enable the shippers and the government to detect discriminations in railway rates more readily. Moreover, this would simplify the problem of state regulation.

The establishment of a uniform classification does not seem practicable at the present time, although the conditions now prevailing are far better than those were which obtained in 1887 when the Interstate Commerce law went into force. Until that time nearly every large railway had its own classification, there being about 40 different classifications in the present "official" territory. In order to observe the provisions of the act of 1887 prohibiting unreasonable personal and place discriminations, a consolidation of freight classifications was necessary, and the result was the working out of the Official, Southern, and Western groupings. This was followed, during the years 1889 to 1892, by an attempt to amalgamate these three main classifications, and the few minor ones still in use, into one uniform classification. This effort was unsuccessful, because the industrial conditions in the Eastern, Southern and Western sections of the country were so divergent as to make the establishment of a single classification of traffic seem impossible, unless a large number of commodities in each section of the country were omitted from the classification. To make a great number of exemptions would largely defeat the object of a uniform system. Indeed, at the present time, with several classifications, an unfortunately long list of commodities is omitted from the classes. Coal, livestock and certain other kinds of traffic are very properly exempt from classification; but the railway companies are constantly being urged by men who are developing new forms of production or are opening up new resources to give them the advantage of special or "commodity" tariffs. The railways do not favor such exemptions unless the new traffic cannot be secured without the assistance of a special commodity tariff; but the fact that some of the large railway systems have over a thousand commodity tariffs in force shows how potent are the shippers' appeals.

Freight is designated "local" or "through." A shipment between two points on the same line of road is local freight; while through freight is that which comes to the railway company from some other railway, or is that which starting at some point on one line is turned over to some connecting carrier. Through business is that which requires the services of two or more railways. In general, local freight is short distance traffic, and through shipments correspond to long hauls; but this is frequently otherwise, especially since our railway systems have come to include lines many hundred miles long.

Through Freight.—In the management of their through or "joint" traffic the railway companies have made great advances. During the first two decades and a half of railway history each company owned a short trackage, and freight sent between distant points usually had to be rehandled at several junction points, because each company preferred to keep its equipment on its own lines. This method of conducting business was expensive and added greatly to the delays and risks of shipment. Some method of making inter-line shipments

without breaking bulk became necessary and the need was largely met by the organization of the "fast freight lines" or freight despatch companies. These organizations date from 1855-6; and, although their original character has changed and several have ceased to exist, they still survive in name. The Union Line, the Empire Line, the Merchants' Despatch, and others of a similar character are organizations with which the public is familiar. At the outset the fast freight lines were managed by corporations distinct from the railway companies. The despatch company solicited freight from shippers, provided its own cars, charged such rates as the conditions of competition permitted, and paid the railway companies for hauling the cars. The nature of the services performed by the fast freight lines may be illustrated by referring to the history of the Empire Transportation Company chartered by the State of Pennsylvania in 1865. This company was organized to increase the business done over the Philadelphia and Erie Railway, which connected Sunbury and Erie, Pa. This road was only a part of one of the through routes between the Atlantic seaboard and the Great Lakes and the oil fields of western Pennsylvania. The Empire Transportation Company, in order "to increase convenience, promptness, and safety, in the transfer of property between inland points . . . and points on the Atlantic slope and seaboard and in foreign countries east thereof," built pipe-lines within the oil regions, constructed terminals at the seaboard and the Great Lakes, and organized transportation companies to operate on the Lakes and over the railway lines west of Pittsburgh and Erie. Such an organization as this could perform a useful service. It developed new traffic, it solicited business, it provided itself with rolling stock and thus relieved the railways of supplying specialized equipment at a time when capital was not abundant. The conditions have now changed, however. The railway systems have become so extensive, and their interline relations have been so developed, that the railways are able to perform practically every service which the shipper may require. Every railway will take freight and issue bills of lading for any point in the United States, and, indeed, for many places outside of our country. Most of the despatch companies were brought out by the railways between 1870 and 1880 and converted into "co-operative fast freight lines," which were in reality only joint arrangements among connecting roads to facilitate their through business. Each co-operating road assigned to the joint line a number of cars proportioned to the mileage of its system, and the earnings and expenses of the joint lines were divided proportionately among the constituent companies. These co-operative freight lines thus became essentially an arrangement among certain railways for securing an inexpensive and honest administration of their interline business. This co-operative form of organization put an end to an abuse that was connected with the former independent fast freight line or despatch companies which were frequently owned by the officers and directors of the railways for whom it was profitable to favor the freight line at the expense of the railway corporation.

The consolidation and growth of railway cor-

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porations and the development of vast systems are rendering even the co-operative fast freight lines unnecessary. In many cases they continue to exist, but are regarded rather as trademarks of which continued use is made because shippers have become accustomed to sending their freight by certain routes and by particular bills of lading. In keeping the record of the cars, and in settling interline accounts the freight lines are of service to some companies; but the time is probably not far distant when each company will manage all its freight business directly through its own freight department.

A prominent characteristic of the American railway service is the specialization in the freight equipment. For each commodity (like coal, iron ore, petroleum oil, livestock, dressed meats, fresh fruits, etc.) that is shipped regularly and in large quantities there is provided a type of car constructed with reference to the most economical carriage of the traffic. Most of the special-service cars are provided by the railway companies; but a large part of them is owned by the shippers. In times past even greater use was made of private cars than is customary at present; and even now there are probably 125,000 of the shippers' cars, or one seventh of all the freight cars in the United States. The use of private cars will probably decrease in the future, because a large railway corporation doing business in several States can derive more profit from providing all the equipment required for its traffic than from renting private cars for any considerable portion of its business.

When personal discriminations were generally practised the owners of private cars had a great advantage over other shippers, not only because they offered the railways a large tonnage, and could thereby secure a low rate; but also because the car-mileage exacted of the railways by the owners of the private cars was the source of large gains. The private cars usually are devoted to long-distance one-way traffic, which means a disproportionately large mileage for such cars as compared with the others, and that the private cars must be hauled without a paying load half the distance they are moved. Although the customary car-mileage charge has been reduced nearly one half during the past decade the railways continue to prefer shippers to use the railway company's equipment. From the standpoint of government regulation and the prevention of discriminations, the substitution of the carrier's equipment for that owned by the shippers is desirable.

The volume of long-distance traffic and travel in the United States is so great that each railway company is practically obliged to bill freight and to ticket passengers to points on the lines of many other companies. The freight and passenger cars used in handling this joint and through business move freely over the tracks of numerous companies, and an elaborate system of car-records and interline accounts becomes necessary. In Great Britain, ever since 1850, all joint traffic has been handled on way-bills and tickets of a "clearing house," through which the railway companies settle their interline accounts. This method of doing business and settling joint accounts is economical, and makes secret rate cutting on through business practically impossible. There has been much discussion regarding the adoption of the clearing-house method of

handling through rail traffic in the United States, but the size of the country is so vast and the number of the companies is so great that a single clearing-house for the entire country seems hardly possible. It might be feasible to operate a clearing-house within each of the half dozen leading territorial groups of American railways; and the progressive consolidation of our railways under a decreasing number of managements will simplify the problem of inaugurating the clearing-house method of managing inter-railway traffic.

The Passenger Service.—In many ways the passenger service differs from that of carrying freight. Freight is handled mainly in car loads or train loads and the car or train is started whenever the cargo is completed. The passenger service, however, is performed by trains that run on fixed schedules quite regardless of the number of passengers that may desire to travel at the time fixed for the train to start. This distinction does not apply in all cases because some kinds of perishable commodities are moved by freight trains that are run in accordance with fixed schedules, but in most instances the distinction holds good. In the passenger service more than in the freight business attention must be paid to speed, safety, comfort and convenience. Although quickness and regularity of service is required of the railways by some shippers the chief demand is for cheap transportation and low rates. Consequently, railway companies are under constant pressure to reduce the cost of handling and hauling commodities. In the development of their passenger service, however, the railways are seeking to increase the speed and safety, and to lessen the discomforts of traveling. Probably, American railway companies have underestimated the demand for cheap passenger fares, but they have unquestionably acted upon the theory that excellence rather than economy has been the demand of the traveling public. The result of following these different aims in the development of the freight and passenger service has been that the average freight train load has nearly doubled since 1890, that the average freight train mile revenue has risen nearly 50 per cent, and that there has been a large decline in freight rates—23 per cent during the decade 1890-1900; whereas the number of passengers per train is no greater to-day than it was in 1890, and there has been an actual decrease in the revenue per passenger train mile, and there has been only a relatively slight reduction—7 per cent—in passenger fares since 1890.

Contrary to ordinary belief the American people make comparatively small use of the passenger service offered by the railways. The people of the United Kingdom take nearly twice as many trips each year as the people of the United States do, although there are about twice as many persons in our country as there are in the United Kingdom. The Briton takes 27 rides each year, while the American averages about 7½. As regards the number of trips per year the average per person in the United Kingdom is 27, Belgium 17, Switzerland 15, Germany 12 and the United States 7½. The American travels a few miles more each year than does the inhabitant of any other country except the United Kingdom, but even the people living in such small countries as Germany and France travel almost as

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many miles annually as does the average person of the United States. One way to show the use made by the people of different countries of the railways for travel is to compare the number of miles traveled per mile of the railways. In Great Britain the number of "passenger miles" per mile of road is about 400,000; in Germany, 343,000; in France, 283,000; and in the United States, 72,000. While it is to be expected that the railways serving such densely populated countries as the United Kingdom, Germany and France will have a greater passenger traffic per mile of line than will the railways in a relatively sparsely settled country such as the United States, the foregoing figures nevertheless indicate that the American railways can do much to increase travel in the United States.

One method of accomplishing this would be for the American railways to follow the example set by the roads of Europe and to divide passengers into classes. As a matter of fact, there is some classification in the American passenger service, there being the Pullman service above the so-called first class, and a second class; but Pullman cars are run on relatively few trains, and many roads sell no second class tickets. In all European countries there are at least three classes, and in Prussia there are four, besides a separate class for the military. The trend of traffic has been from the upper to the lower grades as the result of increasing travel by the poorer people and the improvements in the comforts to be secured. In the cheaper grades of service the average passenger fares in the Continental countries of Europe are much lower than in the United States. The average receipts per passenger per mile in Prussia are 1.05 cent, in France 1.02, in Hungary about 1.01 cent, and in Austria, about 1 cent. In the United States the average earnings per passenger mile are about 2 cents.

The success which has resulted from the improvement and development of the lower and cheaper grades of service of the European railways suggests that it might be advisable for the railways in the United States to develop a service below that of the ordinary first class day coach, and to make the fares for this inferior service considerably cheaper than those now prevailing. In order to increase their passenger business in a large way it would be necessary for the railways of our country to make it possible for the masses of the people to travel economically. The demand of those who work for small wages is for a cheap service and not for luxury.

To some extent the demand for a cheaper passenger service is being met by the extension of inter-urban electric trolley lines. In many places electric lines have introduced a service cheaper, slower and less comfortable than that offered by the steam lines, and the result has been the development of an enormous volume of local traffic. There are instances of the construction of trolley lines parallel with trunk line railroads and the development of a local traffic 20 times that previously handled by the steam lines. This enormous traffic by trolley has, however, not lessened the travel by steam roads, but has developed a traffic that previously did not exist.

The Express Service.—In the United States a rather sharp distinction is made between ex-

press and freight traffic although in each case commodities are transported. Express traffic consists of the articles other than mail matter and personal baggage that are carried on passenger trains. Some express goods are carried in train loads but this is exceptional even at the present time; and occasionally ordinary freight is sent as express in order to secure especially prompt delivery. Express companies also sell money-orders payable at any of their offices and they sometimes collect accounts and execute papers. In foreign countries the express business is conducted either as a part of the freight service of the railways or as a part of the postal service. The United States receives no package for the mails weighing more than four pounds except in the case of a single book, whereas many foreign countries accept packages weighing 11 pounds for carriage by mail. The reason why the American railways do not handle the express business is a historical one. During the first decade of the development of the railways in the United States there was no special organization for handling express business. The patrons of the roads, however, began to send packages from one station to another by entrusting them to the conductors or baggage agents. In 1839 William Harnden began receiving parcels for transmission between New York and Boston. The following year Alvin Adams began to compete with him in the New York and New England business. Harnden then began the express service between the United States and Europe, and 14 years later Harnden, Adams, Thompson and Kinsley consolidated and became the Adams Express Company. The American Express Company grew out of a consolidation which took place in 1850. Wells, Fargo and Company started in 1852, the United States Express Company in 1854, and the other important companies organized soon after that date.

The railway companies of the United States found it convenient and profitable to permit the express companies to organize and develop the parcels service. Each railway corporation makes a contract with an express company giving it a monopoly of the express business over the lines included in the agreement. The railway company furnishes the cars and hauls them for the express company and obtains therefor from 40 to 60 per cent of the total receipts of the express company, the percentage of the total receipts paid to the railway being dependent upon the volume of the express business. In the Eastern States where the traffic is heavy the railways receive 40 per cent. In the contract between the express and railway companies it is usually stipulated that the minimum express charge shall be from 50 to 150 per cent above the rates which would be charged for carrying the articles as ordinary freight. In actual practice the express charges average from 3 to 4 times what the freight rates would be.

The necessity for separate companies to perform the express business is no longer urgent. Indeed it is probable that it would be more profitable for American railway companies to develop their freight service so as to include the collection, carriage and delivery of most of the parcels now handled by the express companies. It is also the opinion of many experts that the time has come for the United States

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government to include in its mail service the carriage of parcels up to the weight of 10 pounds. By doing this and by perfecting its money-order service the United States government would with profit to itself and convenience to the public perform a large part of the business now done by the express companies.

The Mail Service.—The transportation of the government mails is an important branch of the railway service. Over 8,000,000,000 pieces of mail matter are now handled annually in the United States mails, and the weight of this mail exclusive of the sacks and equipment used in handling it probably exceeds 350,000 tons annually. Although the United States employs steamships, stage coaches and messengers as well as railways to handle its mails, over 86 per cent of the total weight of the mails and equipment is carried by the railways. On 50,000 miles of railways "railway post-offices" or cars equipped as post-offices are run. These cars are in charge of messengers who sort the mail as it is received and place it in special pouches, there being pouches for each city, and usually pouches for each of many sections of the city. On nearly 120,000 miles of railways department mail cars are operated, and on about 20,000 miles of railways the mails are carried in closed pouches usually in the baggage cars. From these figures it would seem that our mail service makes use of nearly 190,000 miles of steam railways. The messengers and crews in charge of the mails travel nearly 250,000,000 miles annually. The railway post-offices have come to be an indispensable feature of the service. The plan of sorting mail while in transit originated in 1862 with William A. Davis, who then fitted up the first railway postal cars. The advantage of using such cars was quickly recognized and they were soon in operation on the principal mail routes. The postal cars now built are from 40 to 60 feet in length, and the government is constantly increasing the number used. To the extent that the distribution of the city mail can be transferred from the post-offices to the postal cars to that extent the delivery of the mails will be expedited. The payments received by the railways for carrying the mails are determined in accordance with Acts of Congress passed in 1873, 1876 and 1878. The basis of payment is the weight of the mails and the distances carried, and, if handled in full-size postal cars, the number of miles such cars are operated. The following table states the amount of payment received by the railways for different weights of the mails and also indicates the equivalent rate per ton per mile for handling this traffic.

RATES BASED ON THE WEIGHT OF THE MAILS.

Average daily weight of mails over whole route	Pay per mile per annum	Rate per ton per mile
200 pounds.....	\$42.75	\$1.171
500 pounds.....	64.12	.702
1,000 pounds.....	85.50	.468
1,500 pounds.....	106.87	.390
2,000 pounds.....	128.25	.351
3,500 pounds.....	149.62	.234
5,000 pounds.....	171.00	.187
Each 2,000 pounds in excess of 5,000 pounds.	21.37	.058

The rate per ton mile received by the railways for carrying the mails declines rapidly with

the increase of the average daily weight of the mails handled. It is because of this that the railway companies to-day are receiving a lower rate for carrying the mails than they formerly obtained although there has been no change in the provisions of the law for 25 years. The average daily weight of the mails is ascertained by weighing the mails for 30 successive days once in four years. The average of those 30 days is assumed to be the average for each day of the year and the payments for the succeeding four years are based upon those figures. As the amount of mail business increases yearly the railway companies during the latter part of the four year period are not paid for as great a weight as they actually transport. It is estimated that they are paid for 91 or 92 per cent of the weight of the mails carried.

The rates allowed for hauling full-size post-office cars and the equivalent rates per mile run by the cars are shown by the following table:

RATES ALLOWED FOR FULL-SIZE POST-OFFICE CARS.

Length of car	Rate per annum per mile of track	Rate per mile run by cars
40 feet	\$25.00	3.424 cents
45 feet	30.00	4.109 cents
50 feet	40.00	5.479 cents
55 to 60 feet.....	50.00	6.849 cents

It has frequently been charged that the government is unduly liberal in its payments to the railways for carrying the mails. For 20 years the United States has annually paid the railways about one third of the total amount of the postal receipts. When compared with the payments made by other countries this rate is not found to be exceptionally large, and while the remuneration made by the government to the railway companies is ample it can hardly be said to be excessive. See POST AND POSTAGE.

The Organization of the Railway Service.—The agency by which the railway service is performed is a corporation, and on account of the complexity and multiplicity of its duties it is necessarily a highly specialized organization. Like other corporations it has departments and officials for the management of its financial and legal affairs, but in addition to this, it includes a special transportation organization to which four duties are entrusted. One duty is the construction and maintenance in proper condition of the roadway and all necessary structures. The second is to provide and keep in proper repair and to operate the equipment which the traffic may require. The third is to furnish the facilities that will enable passengers and shippers to make use of the transportation service, and the fourth duty is to arrange and adjust the relation of the carrier with its patrons in such a way as to further the interests of both parties. Corresponding with each of these four duties there are separate departments of the service within each of which there is a minute subdivision of duties and responsibilities. From the bottom to the top of the service there runs an unbroken line of responsibility, each employee being responsible to his superior, while the president of the company is under the control of the Board of Directors who must give an account of their management to the stockholders. Corporate organ-

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ization has reached its highest stage of development in some of the larger railway systems of the United States. The railways in the United States now employ about 1,100,000 men. Unless agriculture be considered as a single industry it is proper to speak of the railway business as the greatest of all the industries. This vast army of railway employees consists to a large extent of skilled laborers who are well paid, are well organized and are steadily adopting higher standards of living. Their influence upon the progress of American labor is far-reaching and altogether beneficial.

Co-operation in the Railway Service.—The railway service is of such a nature that it must be performed by large corporations. Moreover, it is absolutely essential that these corporations should co-operate with each other; not only must they work together in the management of their joint business, but they must also co-operate in the regulation of their competitive traffic. The history of American railway transportation shows conclusively that there must be co-operation among railways if the public is to receive an adequate service at rates that do not unjustly discriminate between persons, places or classes of traffic. The United States and the several State governments have passed many laws prohibiting the co-operation of competitive railways, but such laws have always been inefficient. The necessity for co-operation among railways grows out of the public nature of the service they perform. Railway transportation being a service of a public nature which may be performed directly by the government or by agents authorized by the State, it must be conducted in such a way as to minimize discriminations between persons and localities. For each railway, to compete independently of other roads, by bidding for traffic is to introduce intolerable discriminations. The United States very properly prohibits railways from making unreasonable discriminations, but it makes the mistake of prohibiting that degree of inter-railway co-operation that is necessary for the establishment and maintenance of equitable charges. While the best performance of the railway transportation service and the prevention of discriminations requires that the railways shall be permitted to co-operate, the conclusion is not to be drawn that the railway corporations should be permitted by the government to perform their service and to make their charges without governmental regulation. The proper adjustment of the relation of the carrier and the public requires the supervision of the service by the government, and the correction from time to time of unreasonable discriminations. This is not merely a theoretical statement, but is a deduction fully warranted by the history of railway transportation.

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Railway Yard Switching.—Switching or shunting cars is a term commonly applied in steam railroad yards where freight and passenger trains are prepared for road service and for further distribution of cars at terminal points, the preparation of a train at a terminal point for dispatching to another terminal point and so prepared as to reduce to a minimum extra handling of a train while enroute.

The construction of railroad yards in reference to track arrangements for switching purposes, the equipment of cars and engines, fixed signals, and other facilities requisite to yard operation, have been given much attention by prominent railroad men, and through the periodicals given much publicity, which has done much good in bringing about a higher state of efficiency, but little has been written relative to switching, which, in a general way, means interior operation.

The character of business to be handled regulates the manner in which the switching is performed, therefore, there can be no established rule to govern all yards where switching is done, but taken as a whole, a large per cent. of the rules will apply to all yards and are in effect.

At terminal stations, where trains are received and despatched from the same yard or intermediate yard, the switching is separate and distinct and must, therefore, be divided into two classes as follows:

- | | |
|--|---|
| Make up yard,
Trains prepared
for road service. | <ul style="list-style-type: none"> a. Accumulation of loaded and empty cars. b. Inspection and weighing cars. c. Separation of cars into classes. d. Despatch of trains. |
| Break up yard,
cars separated
for final
delivery. | <ul style="list-style-type: none"> a. Trains from the road to be switched. b. Inspection and seal record of cars. c. Classification by switching. d. Movement to final destination. |

In the make up yard, where trains are prepared for road service and in break up yards, where trains are received from the road, the switching is performed by engines of a type especially adapted to yard service. They are constructed with a short wheel base, which is very essential to the work, as many yard and industry tracks are of very sharp curvature and on which engines of longer wheel base, such as those used on road service, could not move without danger of derailment. They are also of sufficient weight and steam pressure to handle the maximum number of cars received or despatched on one road train.

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In the preparation of a road train, cars are assembled into a receiving yard from various places. Cars are loaded at industries, public team tracks, freight houses, and, after the billing for each loaded car has been prepared, showing the weight, contents, and destination, the cars are collected together by the yard engines, which are assigned to industry and freight house work, and are taken to the receiving yard, where all freight is collected for an outbound movement. The yard, or shifting engines, which perform this and similar work, is all the while under the supervision of the yard master. The crews are composed of the following: one engineman, one stoker, one engine foreman, two helpers. The engine foreman is known as the conductor and the two helpers are known as yard brakemen or yard switchmen. The entire crew is subject to the orders of the engine foreman.

The freight in cars ready for transit, taken from local team tracks, industries, etc., on the road where the switching is done, does not comprise all of the channels from which freight is received, but to the contrary forms only a meagre part of the freight received for shipment. By means of a common interchange or reciprocal arrangement between connecting line roads, which have business relations and are amicable according to a mutual understanding, loaded and empty cars are continually received from connecting roads, which must undergo the same inspection before being switched into road trains as the cars received from other sources.

This freight, being composed of various commodities, live stock, perishable, and dead freight, is then switched into road trains for despatching. It is classified by the switching crews in division or station order, the live stock and perishable freight being given preference and where solid trains of high class freight cannot be run, the train is then filled out by adding additional cars of less important freight, which in railroad circle is termed, "dead freight." This dead freight is added to a train of high class freight until the proper tonnage is acquired to complete a train.

The shifting crews assigned to the make up yards must be men of experience, as a general knowledge of the routing of cars is necessary and can be only acquired by long service and close application to the work, to prevent errors in wrong routing to cars. Cars for the various divisions of a road are switched to tracks which are assigned to a division of a road, the live stock and perishable is switched to tracks assigned for preference trains, dead freight, empty cars, etc., are assigned to other tracks, etc., until there is a complete separation of the freight in building up the road train.

On some terminals, this switching is performed by gravity or hump method, the yard tracks being so constructed as to have an elevation or hump at the head of the make up yard. The cars are detached by the engine foreman singly or in groups, as the classification may require, after which they attain sufficient momentum to gravitate into the yard track to which assigned. Where this method of yard operation is in force, the number of men assigned to an engine is very greatly increased. In yards where heavy business is handled, twenty or more men work with one engine, who bear the title, "Car

riders," their duty being to ride the cars into the track to which it is assigned and reduce the momentum of the cars by applying the hand brake to prevent them striking cars already on the tracks with more force than is necessary to have them couple together automatically.

The switch tracks used in the operation of a gravity yard are usually operated by an interlocking plant, the same being located at the summit of the elevation which affords a clear range of vision for the interlocking operators to all of the tracks in use. The duty of the interlocking operator being such as to require him to work in conjunction with the engine crews in disposing of cars to the various tracks assigned. A switching list is first prepared in duplicate and a copy furnished to the interlocking operator and the engine foreman, which indicates cuts or separations to be made in the train. By this method the engine foreman and crew and the interlocking operator work in unison which is necessary to prevent cars from entering tracks which they do not belong. After each cut of cars or yard train has been switched and the cars travel into the tracks to which they are assigned, the car riders, who protect the cars down into the yard, are collected up by the engine which was used to shove the train over the hump. In some yards a special engine is used for this purpose and the men are collected and brought to the summit of the hump to be ready to protect another run of cars. Frequently two yard engines are used in the operation of gravity method of switching, which reduces the amount of delay in the work and increases the number of cars handled without increasing the number of car riders.

The gravity tracks are constructed on a three per cent. grade for a given distance and then are reduced to a two per cent. grade and the yard tracks to one-half of one per cent. grade or just sufficient grade to carry the cars to the desired stopping point.

When a sufficient number of cars shall have been accumulated to make a train of the required tonnage, a road train crew is then called to move the train, consisting of an engineer; fireman, conductor, and two brakemen.

With the growth of the business and the large increase in the number of cars handled at terminal points, it was evident that something better than the switching list for the guidance of the yard crews was necessary and the side carding of cars was inaugurated to designate the routing and the destination of cars, which was found to be practical and is used to quite an extent. Cards of various shapes and colors are used, each color and shape having its meaning, and it is found to be a large factor in facilitating the work, as the yard men soon become accustomed to the cards, which are securely tacked on to the side of the car, and without having to consult the card way bill or the switch list, which accompanies each loaded car, they are able to direct the car to the track to which it belongs, being guided by the color, design, or number of the side card. These side cards, which are put on by the yard clerks, show the contents and destination of the cars and have no value or particular use after the road train is ready to depart, as it is merely a symbol for the guidance of the men when building up a

RAILWAY YARDS

train, thus expediting the work. This system is called "side carding."

In receiving yards where road trains are disposed of, the character of the business, in a measure, is similar in most respects, as far as yard operations is concerned, to yards where trains are made up for road service. A train for the road, arriving from a terminal point, is switched according to its classification and the class of freight included in the train, its destination, etc., regulates, in a measure, the amount of switching to be performed to break up and dispose of the train. If the train consists of loaded cars for freight houses and team track delivery, very little switching is necessary, for the reason that the cars are immediately placed at the freight houses and team tracks for unloading. Carloads of freight for freight houses are unloaded by freight handlers and is stored in the freight house, the consignees, or owners of the goods, being advised of the arrival of such freight, by the freight agent. Cars loaded with commodities other than merchandise, which are unloaded on the team tracks, are handled by the agent and the owners notified in a similar manner, to release the cars.

Trains bearing cars which are through billed or for local industry switching are more difficult to dispose of and require more switching, as additional classification is required. Therefore, a train consisting of the maximum number of cars to complete the tonnage may have twenty or more classifications in order to properly separate the cars and must be separated on to as many tracks as there may be classifications. Yard trains are thus built upon the classification tracks, subsequently delivered by yard engines. The empty equipments, which do not belong to the road performing the switching, are handled the same as loaded cars for connecting line delivery and are disposed of in a like manner.

When a road train arrives at a terminal station, the seals on all loaded cars are carefully inspected by a yard clerk and a record taken to determine if the seals remained intact while the car was in transit and if the contents of the cars remained undisturbed. The train is then inspected by a car repair man for its physical defects, safety appliances, etc., before the train is allowed to be switched. The broken or damaged cars are marked for the repair track and are switched to tracks prepared for that purpose, which is known as the "Rip" or "Shop" tracks. After the repairs have been completed, the cars are again switched into the train for a delivery by a yard engine to the yard or road to which the car may belong. In further preparation of the train, it is sidecarded the same as cars switched into road trains ready for departure. The cards, which are of various color and designs, also bear numbers—the color designates the road or yard to which the car is assigned; the figure designates the number of the freight house or team track to which the car may be assigned; the color of the card designates the connecting line or local district to which the car belongs. All this is of great convenience to the yard employees in switching, as it only becomes necessary for them to observe the color of the card to guide them as to the general direction which the car is to travel. When the cars are moved to auxiliary yards, the cars are placed at the various freight houses

or team tracks by yard engines, the yard crews being governed by the figures or notations which may be on the side cards.

In drilling cars from road trains in a break up yard and separating them into classes, they are assigned to tracks in the classification yard, subject to transmission to destination as fast as a yard train has accumulated. When yard trains are delivered to connecting line roads with whom the reciprocal arrangements are in effect, the same engine and crew move a train to the home road on their return, eliminating a light engine movement, which otherwise would be necessary.

Thus the yard power and forces are kept continuously in action day and night, as a mere closing down for a short period would result in yard congestion and delay to freight.

W. J. PRINDLE,

General Yard Master, Pennsylvania Lines, West.

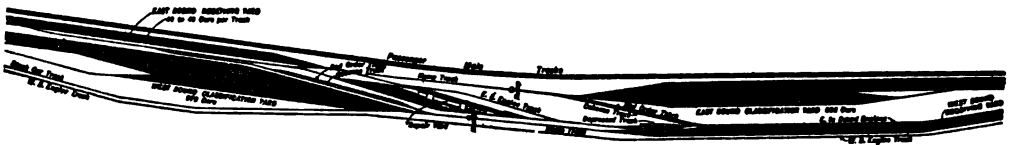
Railway Yards. A railway yard is a series of tracks and groups of tracks provided at intervals along a line of railway and at its terminal points for the purpose of switching and storing cars, and the distribution of cars and freight. The intervals between the yards are usually from 100 to 200 miles. The yard includes facilities for changing and taking care of locomotives, and at important points there are also facilities for handling passenger cars and trains, but the principal feature is the freight service. The main features of a railway freight yard are to receive trains passing over the road, to separate and classify the cars for their proper destinations, and to put the cars together into trains for forwarding. The quicker these operations are performed and the less time the cars are detained by them, the higher will be the efficiency of operation of the yard.

Passenger trains and through freight trains require little attention beyond the changing of engines at division points and the inspection of brakes, wheels, etc., to see that the trains are in safe and proper condition. But general freight trains are composed of cars of various commodities and for various destinations; they have therefore to undergo a series of switching movements at intervals to separate and classify the cars. Cars brought in by local trains from stations along the division tributary to the yard must be classified and distributed for outgoing through and local trains over the next division. At junctions with branches or with other lines of railway the incoming cars must be classified and distributed into similar trains for the different routes. At certain yards, also, it may be necessary to break up the incoming trains and rearrange the cars in lighter trains to be taken over the heavy grades of a mountain division. Some yards provide simply for the redistribution of cars in trains, for forwarding over the next division, or for interchange with connecting railways. Others, as at large terminals and cities, may include the distribution of cars to (and their collection from) freight houses, warehouses, team tracks, factories and industrial establishments, coal and stock yards, coal and ore docks or piers, grain elevators, steamship piers, local or district yards, etc. In addition to handling the loaded cars, it is necessary to collect cars which have been unloaded and to distribute empty cars to points where loads await them.

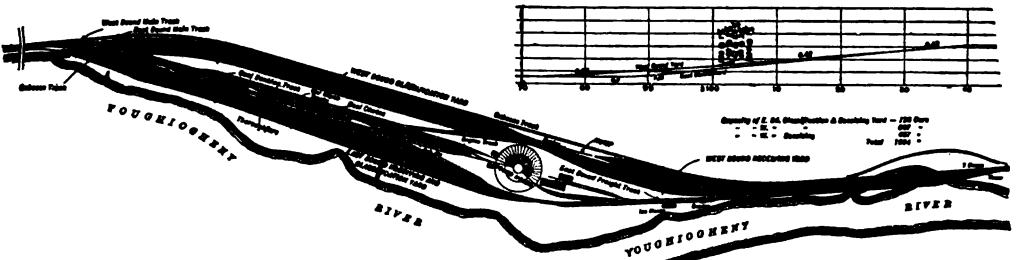
RAILWAY YARDS

Design of Yards.—The design of railway yards is a difficult problem, and especially so in the case of the redesign or enlargement of an existing yard. Many large yards have simply grown by gradual and piecemeal enlargements made without regard to the design of the yard as a whole, and are consequently not adapted for systematic and efficient or economical operation. Within the past few years, however, much attention has been paid to this matter, in connection with the general tendency to increase the efficiency and economy of railway operation. A new yard should be designed with regard to the probable growth of traffic, but also with regard to compactness. If a yard is too large, with tracks of unnecessary length, there will be de-

"body tracks" opening from a diagonal track or "ladder track." The number and length of body tracks will depend upon the character and amount of traffic. Besides these, there will be special tracks and facilities for such work as supplying ice to refrigerator cars, watering and cleaning stock cars, unloading cars, etc. The separate groups must be so arranged in series that the cars will move continually forward in their several switching movements, all reverse movements being detrimental to the highest efficiency and economy of operation. There will be two separate general yards, for traffic in opposite directions, and special provision must be made for special classes of traffic (coal, cattle, perishable freight, etc.) so that fast-freight



Elkhart Yard, Lake Shore & Michigan Southern Railway.



Connellsville Yard, Baltimore & Ohio Railroad.

lay and complication in working the cars through the successive groups of tracks, while the aggregate length of the yard will be excessive, causing considerable trouble and delay in the work. If the yard is too small, however, the tracks will be too crowded for rapid and efficient work, involving frequent rehandling of the cars, while incoming trains may interfere with the regular traffic by being held on the main tracks or station tracks until there is accommodation for them in the yard. In very many cases the design of a yard may be limited by the extent in shape of the land available, and one feature of the problem is to obtain a maximum efficiency on a minimum area. This is of increasing importance in and near large cities, and in some cases it may be found advisable to abandon large city yards (occupying land of high value) and to build new outlying yards with connecting lines to city freight stations or small local yards. The capacity of these city stations and yards may be increased by using freight-houses of three or four stories, the cars being handled by elevators. This has been done in a number of cases in Europe.

The various tracks and groups of tracks form together the yard or "general yard," but each group of tracks for a specific purpose is also called a "yard." Thus a general yard may comprise receiving, separating, classification, storage, repair, advance, and departure yards. Each of these consists of a series of parallel

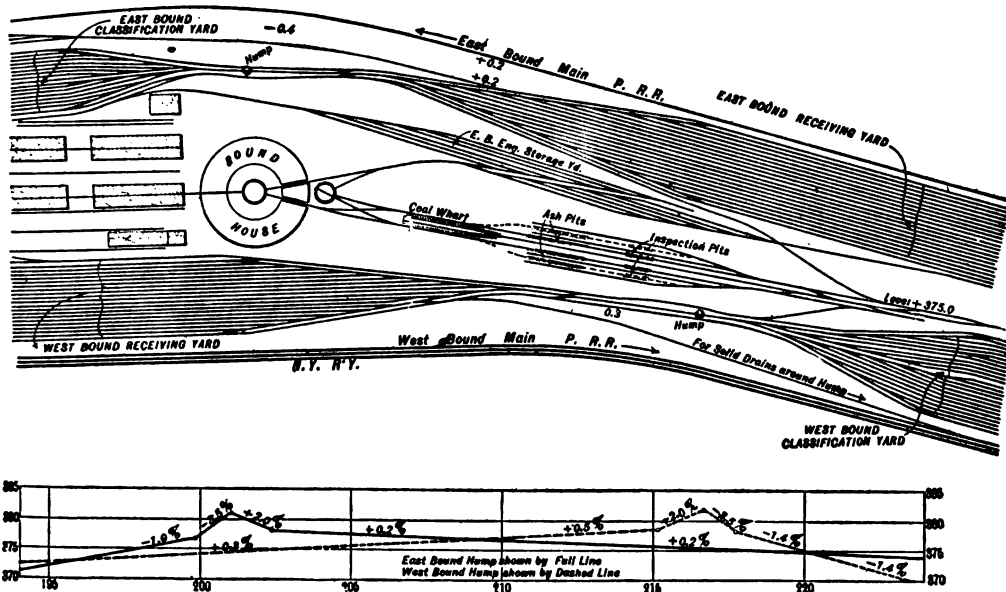
trains can be made up rapidly and both these and through trains attended to without interference with the work of switching or moving the ordinary cars. The illustrations show examples of railway yards.

Mode of Operation.—When a freight train arrives at a yard, it first enters the receiving yard or track, where the engine and caboose are detached, the work of sorting and distributing the cars being taken in hand by a switching engine and crew. The cars are inspected, and marked as to their disposal, which may include some or all of the following: (1) sent on in through trains over the next division or over some connecting road; (2) distribution to stations along the next division by way or local freight trains; (3) unloaded at the yard; (4) distribution to local freighthouses, grain elevators, factories, coal yards, etc.; (5) held for orders or repairs. The cars are then sent to the separating yard, where those containing the same commodity (grain, lumber, coal, etc.) or those destined for the same point are grouped together on the same tracks. The cars are next passed to the classification yard. If the classification is by commodities, each commodity is sorted into groups; thus a string of grain cars from one track in the separating yard will have the cars of wheat, corn, oats, etc., grouped together on separate tracks in the classification yard. If the classification is by districts, cars for the same district are put together in the

RAILWAY YARDS

order required for delivery at destination. From this yard the strings of cars are drawn to the departure yard to form trains ready to proceed over the road, and the tracks in this yard are frequently provided with air pipes and hose connections for testing the train brakes. An advance yard is sometimes provided to relieve the classification yard when the tracks of the latter become filled. The classification yard is the principal feature, and the separating yard is often omitted. With a large number of tracks in the classification yard, the departure yard is also sometimes dispensed with, except at large yards.

than 15 or 20 cars, for convenience of switching; they are arranged in pairs with paved driveways between the pairs. As a rule the tracks are parallel with the direction of the yard, but in many cases space can be economized by placing them at an angle, the tracks opening from a ladder track. In this way, a number of short-stub tracks may be laid out, facilitating the movement of both cars and teams. This arrangement is also sometimes adopted with freighthouses, the houses taking the place of the driveways. (3) The storage tracks, on which cars are held awaiting orders, should be connected with ladders at each end; otherwise



Enola Yard, Fairview, Pa. — Pennsylvania Railroad.

Length of Tracks.—It is very generally assumed that the length of the receiving tracks should be that of the maximum train hauled over the division served by the yard, but the length varies materially for loaded, partly loaded, and empty trains. If the maximum trains are relatively few, it may be better to make the tracks long enough for the average trains, leaving long trains to be split up on two tracks. The disadvantages of very long tracks have been mentioned, but in the receiving yard these may be reduced by putting crossover connections between the tracks at the middle of this yard.

Yard Arrangements.—(1) The classification yard may have the two ladder tracks parallel, so that all the body tracks between them are of the same length; but there is preference for an arrangement of two ladders at each end, forming a V, and making the middle tracks considerably longer than the others. (2) The team yard, in which are placed the cars to be loaded or unloaded by wagons, is best located convenient to the freighthouses. It should be well paved, to facilitate the movements of wagons, and should be equipped with cranes for handling heavy freight, as well as scales for weighing both wagons and cars. The tracks are generally short, holding not more

there is a tendency to let cars stay neglected at the end of the track, whence it is difficult to remove them, as all the cars on the track must be switched out. (4) The tracks in the repair yard should be short (for convenience of removing cars when ready), holding 12 to 15 cars. They are generally arranged in pairs, spaced about 16 feet and 40 feet alternately, between centres, so as to enable men to work upon the cars. A narrow gauge track for conveying material may be laid in the 40-foot spaces. It is a good plan to provide separate tracks where cars can have slight repairs attended to without the delay of sending them to the repair yard, or can be held until they can be conveniently removed to that yard. Light repairs may be made on the open tracks, but heavy work is usually best done under cover, with facilities provided for heavy lifting.

Track and Equipment.—A railway yard should be well drained and ballasted, laid with heavy rails and kept in good condition, as a good track greatly facilitates the movement of cars. The maintenance of track under such constant traffic is difficult work, and it is good policy to build substantially in the first place. Scales must be provided for weighing cars, which is done while the cars are in motion, and there should be

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cranes and mechanical appliances for the handling of heavy freight. The efficient lighting of yards is a difficult problem, and as a rule no system of lighting is used. Electricity is the only practical method, but great care must be taken to avoid long shadows, so that tall poles must be used. The alternations of patches of light with dark fixed and moving shadows may be more confusing than a uniform darkness to which the eyes become more or less accustomed. Telegraph and telephone communication between the main yard office, the out-lying offices, and the train dispatcher's office greatly facilitate the speed and smoothness of working.

The main tracks may pass through or around the yard (on one or both sides), and should be connected with the yard only at its ends, the connections being fitted with interlocking switch and signal plants. Within the yard the switches are usually operated by hand, but in some cases the switches of a ladder track are operated by levers from a tower. Mechanical operation is not practicable on a large scale, owing to the length and complication of the connections, and the consequent difficulty of working. At large classification yards, however, compressed air and electricity are occasionally used for operating the switches, which are controlled by push buttons or small levers grouped in an elevated tower.

Switching Cars.—The switching or moving of cars from point to point of the yard is effected by locomotives, but in sorting or classifying them three methods may be used: (1) By drilling; the engine being coupled to the rear of the train and running it to and fro on a "drill track" leading to the ladder. Each car, or cut (group) of cars, is uncoupled in turn and runs from the train onto the ladder and into its proper track. (2) By poling; the engine runs on a track parallel with that on which the train of cars stands, and pushes each car (or cut of cars) onto the ladder track by means of a swinging pole attached to the engine or to a poling car coupled to the engine. This avoids moving the entire train for each switching movement, as is done in drilling. (3) By gravity; the cars being allowed to run down an incline or grade. In each case the momentum of the car carries it along the ladder and into the proper classification track, the switches being opened by the switchmen. A slight grade is sometimes used along the ladder to assist the movements of cars. As a rule, a brakeman rides the car to check its speed and stop it at the proper point, preventing damage to cars and contents by running the cars together at high speed. At some large yards, an engine runs to and fro on a special track to bring these men back, thus saving time.

Gravity Switching.—Where the ground at the site of a yard is on a slope, the cars may be started by a locomotive at the upper end and allowed to run by gravity direct to the classification tracks and thence to the departure tracks without further assistance. This plan has been adopted abroad in some notable cases, but there are very few examples in this country. This system of complete classification of cars into both district and station order entirely by gravity movements was first adopted, in 1873,

by Mr. Footner, for the extensive Edge Hill yards of the London & Northwestern Railway, near Liverpool (England). The main part of the yard is on sloping ground, and the cars delivered at the upper end pass through the separating and classification yards (or "gridirons") by gravity, being delivered in proper train order on the departure tracks. From the receiving yard, the cars pass to the separating yards, where each track receives the cars for a particular train. Beyond these are two classification yards through which the cars of each train are passed so as to put them together on the departure track at the foot of the slope in proper order for the train.

Where the natural grades are not suitable for this system, an embankment may be built to form an artificial summit (or "hump" or "camel-back"), having the necessary grades to move the cars by gravity. This is said to have been introduced first in Germany, in 1876, and is now very extensively employed in this country. With proper operation this "hump" system will do the work of handling cars through large yards quicker and at less cost than either drilling or poling, besides resulting in less damage to cars and their contents. The "hump" system is generally employed simply for the classification of cars, the embankment and summit being located on the line of the tracks leading from the receiving yard to the classification yard. There is an easy ascending grade on the side approached from the receiving yard in order to close the cars together and so facilitate uncoupling. Beyond the summit there is a short steep descending grade followed by easier grades continuing along the ladder track to the classification tracks. A train of cars is slowly pushed up to the summit, each car or cut of cars being uncoupled and acquiring an impetus on the short steep down grade which is sufficient to run it into the proper classification track. The grades vary with traffic and climatic conditions, and range from $2\frac{1}{2}$ to 4 per cent. for a distance of about 200 or 300 feet, beyond which a grade of about 1 per cent. extends along the ladder track. Connecting tracks provide for the movement of trains which do not require to be classified. Loaded cars run more easily than empty cars, and all cars run more easily in summer than in winter. Track scales are frequently located on the gravity track, to weigh cars as they pass. The cars on any one track in the classification yard are, as a general thing, not arranged in proper order for handling in trains, so that a considerable amount of shifting approval, but the second gravity movement might be adopted with success for large yards on sloping ground where the cars would move continually by gravity (under control of brakes) instead of having to be pushed up an incline for each summit or gravity track. This would in fact be the continuous gravity system above described.

Buildings.—The buildings required for freight traffic include those for unloading inbound freight from the cars and for loading outbound freight into cars. These are served by driveways for teams. The inbound freight-house must be wide enough to give a proper amount of space for holding freight (50 feet is considered a good width), and usually re-

RAILWAYS, AMERICAN — RAILWAYS, EARLY HISTORY

quires not more than two tracks. The outbound freight-house should be narrower in order to decrease the amount of trucking (25 feet is considered a good width). There is also sometimes a transfer-house for taking small lots of freight shipped in separate cars for the same point, and transferring them to one car, thus getting one full load and releasing the empty cars for service. Where the buildings have doorways at intervals, cars must be "spotted" or carefully set to bring their doors opposite those of the freight-house. This may be avoided by putting a platform outside the house, or by making the track side of the house a series of continuous openings, separated only by piers or columns and fitted with rolling or folding-doors. As many as four rows of cars can be loaded by running trucks through the cars, loose bridges being thrown across between their doors. A very common arrangement is to have the inbound and outbound house parallel, with from three to six tracks between them, and a trucking platform between the tracks. At outbound houses where a great number of cars are required, the trucking of the loads from the freight-house to the cars may be facilitated by arranging a number of stub tracks with the freight-house at their ends; the tracks are in pairs with covered platforms between the pairs of tracks.

Special Facilities.—At large lake or ocean ports, special facilities are required for transferring freight from cars to lighters, barges, and ships. Sometimes, also, there are yards not accessible by tracks, but to and from which cars are carried on large floats. For such work open and covered piers, ferry transfer slips, etc., are required. Coal piers and ore piers may also be required, and these usually have the tracks high above the water, being reached by inclines. The cars deliver the coal, etc., into bins or pockets, from which it is discharged by spouts or chutes as required. In some cases, these piers have machines for unloading coal from cars or ore from vessels into cars. Loaded cars for a coal pier are distributed in a yard with a number of short tracks, so that cars with the same grades of coal may be put together. The empty cars may be placed on a smaller number of long tracks, as no sorting is required. At grain elevators, provision must be made for the steady supply of cars without interfering with yard work. For this purpose a special yard or set of tracks for grain cars to be loaded or emptied is often provided.

Passenger Yards.—Passenger cars and trains must be provided for independently of the freight traffic, but these require little switching except at terminal points where trains are made up or broken up. At these points, the passenger car yard requires tracks for storing and handling the cars, and for cleaning them, as well as for light repairs. The cars may be turned on a turntable (independent of the locomotive turntable) or on a Y-track, the latter being specially convenient where entire trains have to be turned, as it saves a considerable amount of time. The storage tracks should be connected with ladder tracks at each end, but car cleaning tracks are often stub or dead-end tracks, with a supply-house across the end. These tracks should be long enough to take a complete train. Tracks are allotted for or-

dinary cars and for dining, sleeping, parlor, and other special classes of cars. The car-cleaning yard is paved, and is generally supplied with water, steam, gas, and air pipes and electric cables for washing, heating, and lighting, testing the brakes and cleaning the upholstery by the pneumatic process. These pipes are laid between the pairs of tracks.

Locomotive Facilities.—Railways are divided into divisions of 100 to 200 miles in length for operating purposes, and as each division has its own locomotive equipment for both passenger and freight trains it must have facilities for cleaning, storing, and handling the locomotives at the end of their trips. These facilities are usually provided in connection with a freight yard. When an engine has delivered its train into the receiving track of the yard, it is detached and run upon a special track, where it is inspected. It then passes to the ashpit, where the ashpan and grates are cleaned; thence to points where it takes coal, water, and sand. It then usually goes to the engine-house, where it is turned on a turntable before entering the house. Here it is cleaned, has light repairs made, and is held until needed for a return trip. At yards where many engines remain for only a short time before starting on the return trip to their main headquarters, they are sometimes placed on storage tracks in the open air, being sent to the round-house only when repairs are required. These storage tracks may be a series of parallel tracks or radial tracks served by a turntable. As a rule the engine-house is in the middle of the yard, and is of circular or segmental form, with tracks radiating from a turntable. Rectangular houses are, however, employed in a number of cases. The caboose of a freight train is changed at the same point as the locomotive, and the yard must have a special arrangement of tracks to receive and store the cabooses; a good arrangement is to put these tracks on a slight grade so that the caboose can be run by gravity to the rear of an outgoing return train.

E. E. R. TRATMAN,

Author of 'Railway Track and Track Work.'

Railways, American. See AMERICAN RAILROADS; RAILWAY SYSTEMS IN THE UNITED STATES.

Railways—Early History. Railroads had their practical origin in England as long ago as A.D. 1600, although at that time they were practically a rebirth of an undeveloped idea advanced by the early Romans. As strange as it may seem, our modern steel-ways and luxurious methods of land traveling had their origin in the industrial railways that were first roughly constructed to simplify the transit of coal from the mines in Durham and Northumberland, England, to shipping points on the Tyne and Wear. At first, owing to the very heavy roads, planks were laid along the bottoms of the ruts in the roads. The rough carts, fitted with clumsy wooden wheels or rollers and laden with coal and ore naturally made far better progress than formerly, and it was but a little while later, in 1676, that the planks were placed on the level of the roads with sleepers and cross ties laid underneath at fairly regular intervals. As an old English writer puts it, planks of timber were laid "from the colliery to the river, exactly straight and parallel, and bulky carts were made

RAILWAYS, ELEVATED

with four rollers fitting the rails, whereby the carriage was so easy that one horse would draw down four or five chaldron of coals." This method of construction was again improved by filling in the spaces between the "ways" and sleepers with dirt so as not to interfere with the progress of the horses and mules. At this stage of the development of transportation the railroad was known as the "wayleave," and it was found that a horse could easily pull a load of 42 cwt., as against 17 cwt. over the old rough roads. These improved thoroughfares were made across fields, the proprietors of which received a certain rent for the right of way. They underwent little or no mechanical improvement until about 1700, when the wooden beams were clothed with long slips of iron to prevent excessive wear. A more complete improvement, about 1740, was the substitution of cast iron rails fixed in parallel lines on cross wooden sleepers. This construction became general in mining districts by 1775; yet railways did not attract attention as being suitable for general traffic, owing principally to the general interest then displayed in canals.

With the use of cast iron rails the method of traction was improved. Instead of a single large wagon, several smaller wagons were linked together (the germ of the modern train) and flanges were put on the wheels instead of the rails, with a marked increase in traction. Until the invention of a self-acting steam carriage by Richard Trevethick in 1802, the draft continued to be by horses. From 1802 to 1811, numerous patents were taken out leading up to a realization of the fact that locomotives running with smooth wheels on smooth rails could, by friction, draw heavy loads up moderate inclines. In 1814, locomotive power was employed by George Stephenson on the Killingworth Railway with success and was soon afterward applied on the Stockton and Darlington Railway, for which the first Act of Parliament was passed in 1821. This was the first railway to transport passengers, and even with its large measure of success, the locomotive was still a very imperfect machine, with a rate of progress but little faster than the walk of a horse. Acceleration, the main desideratum, was attained by a very simple contrivance, sending the waste steam up the chimney so as to cause a draft in the fire and a resultant rapid generation of steam. By this appliance, with the multi-tubular boiler, the locomotive entered on a new epoch. Notwithstanding the proved feasibility of railroads the public at large were slow to give heed, and in a large measure remained skeptical. The idea of extending railroads for general traffic was perhaps first conceived and urged on the public by Thomas Gray of Nottingham, in 1823 and 1824. In the latter year, Joseph Sanders of Liverpool issued the prospectus of a railway from Liverpool to Manchester, which line, after much opposition, was sanctioned by legislature and opened for traffic in 1830. The success of this line, provided with some of Stephenson's improved locomotives, was immediate and complete and was the beginning of the great commercial enterprise which has since assumed such great importance.

The pioneer American railroad constructed for public use was the Baltimore and Ohio.

chartered in 1827, with 13 miles open for traffic in 1830. Five years later, the length of this road was 135 miles. The Charleston and Hamburg railroad in South Carolina was chartered in 1829 with a completion of 137 miles in 1834. The line from Albany to Schenectady, 17 miles in length, was opened in 1831 and five years later Albany and Utica were connected by rail. In 1842 Buffalo was reached. The Columbia Railroad, the first division of the present Pennsylvania Railroad System, connected Philadelphia and Columbia in 1834. This road was built by the State and was a link in the through route, consisting of canals and railroads, connecting Philadelphia with the Ohio River at Pittsburgh. The Camden and Amboy, connecting Philadelphia with New York, was chartered in 1830 and completed in 1837. The road from Philadelphia to Baltimore was chartered in 1831 and completed in 1837. The Reading Railroad, built mainly for coal transportation, was chartered in 1833 and opened for traffic in 1838. American locomotives were first built in 1830 and were adapted to the light rails, steep grades, and sharp curves of the American tracks. As traffic conditions changed, the engines, cars, and equipments were made to conform to constantly changing designs. American railway mileage presents an interesting aspect. In 1830 there were 23 miles in use; in 1840 there were 2818 miles; in 1850 there were 9021 miles; in 1860 there were 30,635 miles; in 1870 there were 52,914 miles; in 1880 there were 93,296 miles; in 1890 there were 163,597 miles; and from that date to the present time there have been added about 60,000 miles. The 70,000 miles of railroad built in the United States in a single decade (1880 to 1890) was a marvelous achievement unparalleled in the economic history of any other country in the world.

The railway systems of the United States now comprise about 225,000 miles of line, being about two-fifths of the railway mileage of the world. Estimating the cost of railroad property the world over at \$35,000,000,000 it is found that the American Railroads constitute about \$12,000,000,000 of this value. See AMERICAN RAILROADS.

Railways, Elevated. Elevated railways presented one of the first potent factors for the solution of the problem of adequate transportation for passengers between points in great cities. The street railway was an earlier factor, but it met the growing inconvenience of congested streets in only a partial degree, affording but temporary relief. In New York, which city possesses the most extensive system of elevated railways in the world, without taking account of the large system in Brooklyn, now a part of the greater city, two means of relieving the streets of some of the burden of passenger traffic began to be considered as long ago as 1860. Two possible solutions presented themselves, one being to carry it underground through tunnels, and the other to carry it over elevated structures. The former met with more favor at the outset, but the first underground project undertaken was speedily abandoned. Considerable ridicule was expended upon the other idea, but in spite of it an elevated railway, with a single track, was built from Battery

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place through Greenwich street and Ninth avenue to 30th street in 1866 and 1867, and opened to travel on 2 July 1867. It was operated by means of a cable for a short time, when steam locomotives were substituted as motive power. It did not gain popularity as an aid to local travel, and its lack of success caused it to pass into the hands of the sheriff in foreclosure proceedings, and it was sold for the benefit of creditors in 1871.

The West Side (Patented) Elevated Railroad Company, as the corporation which built and operated this pioneer elevated line was named, was succeeded by the New York Elevated Railroad Company, organized 3 Jan. 1872, under a charter granted by the State legislature the year before. A few months later, on 17 June, the Gilbert Elevated Railroad Company, which obtained a charter earlier in that year, was organized to build a line projected by Dr. Rufus H. Gilbert, and which was planned to be a pneumatic tube railway, suspended from lofty arches. For some reason the pneumatic tube idea was abandoned, sustaining at first a modification which, by cutting off the upper half of the tube, made it a mere trough wherein the cars were to run, and it was decided to build a simple elevated railway. Meanwhile there had been not only lack of encouragement for this sort of enterprise, the West Side experiment not having succeeded yet in overcoming popular prejudice, but there was antagonism on the part of property owners who would be affected by the construction of such railways, and there was friction also between the two existing companies. Litigation assisted to complicate and delay matters.

This was the condition of affairs when, in 1875, the State legislature passed what is known as the Husted Act, which provided for a commission to decide as to the necessity for an elevated railway system in New York city, and to determine proper routes. Under this act a commission was appointed by the mayor of the city on 1 July 1875, and after a number of hearings given to all who favored or opposed such a system the decision arrived at was a favorable one. The commissioners announced on 11 December that their work was ended, the routes which they selected being four in number and including respectively Ninth, Sixth, Third and Second avenues. The work of building the lines was assigned to the two companies then existing, and both companies entered at once upon active construction and into equally active litigation, while each was under the necessity of defending the constitutionality of its charter against the attack of citizens, who were determinedly opposed to both. The New York Elevated had extended its line from the South Ferry to 61st street and Ninth avenue in 1876, and had opened it for travel to 59th street. About this time the enterprise enlisted the interest of Cyrus W. Field, who secured a controlling interest in the company in the spring of 1877. The same vigor and determination that marked his connection with the first Atlantic Telegraph Cable was displayed here, and much of the credit for the eventual success which attended the new departure in urban passenger traffic was accorded to him.

Rivalry between the two existing companies had created much business for the courts in the

meantime; the constitutionality of their charters was questioned; and there were injunctions and counter-injunctions. The Court of Appeals finally was asked to pass upon the constitutionality of the charters, and it sustained them both by a decision which was unanimous. All injunctions were dissolved and work was pushed forward, not only on the pioneer West Side line, but also upon the Sixth avenue line, which had passed from Dr. Gilbert's control and was known now as the Metropolitan Elevated Road. This line, extending from Rector street to 59th street, was opened 5 June 1878. During 1879 the New York Elevated opened its West Side line to 83d street and constructed its Third avenue line which was opened to 129th street the same year. By this time the new means of travel within the city had commended itself to popular favor to such a degree that the permanency of the enterprise was assured. The Manhattan Elevated Railway Company, organized under a Rapid Transit Act, passed in 1875, and chartered on 29 December of that year, took a lease of the roads owned by both the New York Elevated and the Metropolitan, the lease dating from 1 Feb. 1879. From that time the entire elevated system of New York city, of course not including the Brooklyn system, has been known as the Manhattan Elevated Railway. In 1880 the Ninth avenue line was opened to 155th street; a spur from Chatham Square created an additional terminus for the Third avenue line at City Hall; a branch of the same line at 34th street afforded connection with the Second avenue line, which it crosses below grade, and gave access to the Long Island City Ferry from both lines; and a branch from the Third avenue line at 42d street connected with the Grand Central Railway Station.

Financial difficulties, which had repeatedly beset the companies which had undertaken the development of this already gigantic project were of such magnitude in 1881 that the Manhattan went into the hands of receivers on 14 July. After the difficulties had been straightened out and a reorganization of the company had been effected, each year was marked by extension and improvement of the service until the system became what it is in this year, 1904, an elevated railway consisting of four main lines with branches, its total trackage being 117.14 miles, divided as follows: Main lines and branches, two tracks (each 37.68 miles), 75.36 miles; third track, used for express trains, 15.19 miles; sidings, 26.59 miles. The southern terminus of all the lines is at South Ferry. The Sixth and Ninth avenue lines run through Battery Park to Greenwich street, diverging at Morris street, whence the Sixth avenue line extends through Church street to Murray street, through which it reaches West Broadway; it traverses this thoroughfare to 3d street, passes through 3d street to Sixth avenue, which it follows to its terminus at 59th street, the station being at 58th. A branch running westward through 53d street connects it with the Ninth avenue line. From Morris street the Ninth avenue line runs through Greenwich street to Ninth avenue and through that avenue to 110th street, where a double curve on a very high structure carries it into Eighth avenue, which it follows to the terminus at 155th street. The Second and Third avenue lines are one from

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South Ferry to Chatham square. After leaving the ferry they make a sharp turn into Front street; thence through Coenties slip and Hanover square they enter Pearl street, which they follow to and through the New Bowery to Chatham square. They diverge here, the Third avenue line continuing through the Bowery and Third avenue to the Harlem River. At 34th street passengers desiring to reach the Long Island Ferry transfer to a "shuttle" train; and at 42d street another "shuttle" train conveys transfer passengers to the Grand Central station. Trains from City Hall follow the same line, and passengers are transferred at Chatham square to the Second avenue line if they desire it, as well as at the two other transfer stations mentioned. From 129th street at the Harlem River the Third avenue line continues northward, crossing the river by a fine bridge, open also to foot passengers. North of the river the line runs over a private right of way to Third avenue at East 148th street, whence it follows the avenue to Pelham avenue in Fordham, opposite the entrance to St. John's College. Pelham avenue is practically the end of the line, but from this point there is an extension to the Botanical Gardens in Bronx Park, about a half mile farther north. The Second avenue line, after leaving Chatham square, passes through Division, Allen and East 23d streets to Second avenue, through which it continues to the terminus at 129th street and the Harlem River, where passengers going further north transfer to the Third avenue line. Transfers are made at 34th street to either the Long Island Ferry or the Third avenue line via the branch operated on that street. Down-town passengers on either the East or West Side are transferred at South Ferry to up-town trains on the other side. There is also a system of transfers to the surface lines at various points, the transfer costing the passenger three cents extra.

Until 1901 steam locomotives were relied upon entirely for motive power. The matter of substituting electricity began to be agitated in 1885. The first experiments were made with a motor invented by Leo Daft which was kept in service intermittently on the Ninth avenue line, between 14th and 50th streets, from 27 Aug. 1885, until 19 October, when a series of carefully recorded daily runs was made, continuing, except on Sundays and election day, until December 22. The object of this series of runs was to ascertain measurement of coal consumed, etc. The Daft motor derived its power from an insulated third rail. It did not commend itself to the management of the road, and the inventor was unable to make such improvement in it as to secure its adoption. During the latter part of 1886 F. J. Springer operated an electric car successfully on the 34th street branch; and in 1893 an electric locomotive designed by J. B. Enty which was operated by current derived from storage battery, or from a third rail, as might be found necessary, was tried on the same branch with excellent results, but neither of these inventions was regarded as wholly satisfactory. While New York led in adopting elevated railways, it permitted Liverpool, an English city, to be the first in adopting electricity as motive power, the Liverpool Overhead Rail-

way, completed in 1893, adopting it at the outset. In the same year the Inter-mural Railway, a feature of the Columbian Exposition at Chicago, made successful use of electricity in the operation of its cars. It was not until the spring of 1899 that the Manhattan Railway decided to use electricity, and the change from steam as motive power was made gradually, the first trains operated by electricity being run over the Third avenue line in 1901. It had already come into use on the elevated railways in Brooklyn. The number of passengers carried over the system at the present time aggregates far in excess of 255,000,000 yearly, and the daily average exceeds 700,000. The system is under lease to a corporation named the Interborough Railway Company, chartered May 6, 1902.

Brooklyn, which is now one of the boroughs of New York city, has an extensive elevated railway system which, like that in Manhattan and the Bronx, as the two boroughs comprised within the former limits of New York are called, has grown out of independent enterprises which finally consolidated. The first company was chartered 26 May 1874, under the somewhat peculiar name of the Brooklyn Elevated Silent-Safety Railway, afterward changed to the Brooklyn Elevated Railway. It encountered vicissitudes, chiefly financial, and was reorganized 29 May 1884. Other companies were chartered prior to the date last mentioned, and several later. The Brooklyn Union Elevated Railroad was chartered 30 Jan. 1899, to take over the properties of the Brooklyn Elevated, the Union Elevated, and the Seaside and Brooklyn Bridge Elevated railroads. On 7 July, in the same year, the Kings County Elevated Railroad was chartered to succeed an earlier company of similar name. This company was reorganized in July 1899, absorbing the Fulton Elevated Railway. Early in May 1900 this company acquired the Sea View Railroad, and subsequently it and its acquisitions were merged in the Brooklyn Union Railroad, which is, at the present time, a part of the entire system of elevated and surface lines operated by the Brooklyn Rapid Transit Corporation. The first elevated line in Brooklyn was opened in May 1885. At the present time the various lines comprised in the system have termini at Fulton Ferry, the New York and Brooklyn Bridge, the Broadway Ferry, the Williamsburgh Bridge, Ridgewood, East New York, Woodhaven (where trains follow the New York and Rockaway Beach Railroad to Rockaway), and at 65th Street, Bay Ridge. All trains to and from the bridge either traverse the full length of the bridge to New York, or transfer there to the bridge trains, which were operated formerly by the bridge authorities. The same conditions exist in regard to trains arriving at or leaving the Williamsburgh bridge, except that the authorities have not undertaken at any time the operation of the railways on that structure. The total length of all the elevated lines in Brooklyn is 28.70 miles, with a total trackage of 67.82 miles. Electricity was introduced as motive power in July 1900.

Chicago opened its first elevated railway in October 1893, the pioneer company being the Lake Street Elevated Railway, chartered 24 Aug. 1892. Other companies were subsequently

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organized, and there has been here, as in New York and Brooklyn, a series of reorganizations and consolidations which have given to the city a large and convenient system. It is operated by electricity.

Boston also has a fine system, which from its opening has been operated by electricity. The building of an elevated railway system was discussed in Boston as early as 1876, but popular opposition and business interests combined successfully for years to defeat any action by the State legislature, which alone was competent to give the necessary authority. The Boston Elevated Railway Company obtained a charter, finally, in 1894, and the road, which was opened in June 1901, was constructed in a little over two years. Its total length is about six and two-thirds miles, and the total trackage, including sidings, is something over 16 miles.

The elevated railway in Liverpool, England, to which reference has been made previously, was completed in 1893, and was the first in the world to use electricity as motive power.

All of the elevated railway systems mentioned thus far are similar to the ordinary railways, the tracks being constructed upon the same principle, but with somewhat lighter rails, and carrying lighter rolling stock. Their distinctive character is derived from the fact that they are carried upon structures of iron or steel, which practically are bridges or viaducts. The proposition to improve them by the introduction of a monorail system has occupied the attention of inventors and railway men for many years. The Meigs single rail system was one of the earliest to attract general attention, and Joe V. Meigs, its inventor, had the backing of such men as the late Gen. Benjamin F. Butler in his efforts to have it approved by the Massachusetts legislature and adopted by the Boston street railway companies. During the winter of 1879-80 a large and successful working model was exhibited to the public in a large loft, with no charge for admission; and in 1886 an experimental railway about one quarter of a mile in length was erected in East Cambridge, with curves, switches, etc., the operation of the system as shown thereby being quite satisfactory to a large proportion of the many people invited to ride upon it. Nevertheless it failed to commend itself fully, and was not considered when Boston finally was ready for elevated railways. The system, as Mr. Meigs once explained it, consists of turning the ordinary double-rail track up on its edge. Horizontally revolving wheels, in contact with the sides of the upper rail, or stringer, furnish the motion, while the car is supported upon rails placed on each side of the lower stringer by wheels having a groove of 45°, giving the wheel contact with both the top and side of the rail as it revolves upon an axle placed at an angle of 45°. The running gear, it is thus shown, bestrides the track, and one of the advantages claimed for the system is that if the supporting wheels should give way in part or altogether the car would remain upright upon the track.

Eugen Langen's monorail system, the main feature of which is the suspension of the cars beneath the running gear, has been in experimental operation since 1900, on a line from Barmen to Elberfeld, Germany. This line is 8.24

miles long, with 18 stations. It is operated electrically, and the consumption of electric power is relatively small, while high speed is quickly attained. On this railroad the cars are so suspended that even in case of a mishap to the carriers they cannot fall.

Howard Hansel Tunis is the inventor of a monorail system adopted for a line in course of construction during 1904, the termini of which will be Baltimore and Washington, D. C. It will be operated by electricity, and the current will be derived from an overhead trolley which will assist also in holding the cars upright as they travel over a single rail, laid upon the ground as in ordinary railroad building. The line will be an experimental one to the extent that upon its success will depend the building of similar lines in all directions from Baltimore and Washington.

EDWARD S. FARROW,

Consulting Railroad and Mining Engineer.

Railways, High Speed. By "high speed railways" is meant those on which it is attempted to obtain speeds considerably in excess of those customary with the best equipped express trains. There has been a gradual increase in the speed of all railway trains with the development of the art. The roadbed and the track have been improved and made heavier, cars have been made stronger, the running gear has undergone marked changes, and the locomotive has been made heavier and more powerful, all of which have contributed to the greater speeds now common. But the changes have been gradual. There has been no sudden increase which in the limited meaning of this expression could properly be called high speed operation. Except in a few notable instances, attempts to secure high speeds have been merely isolated experiments in which a train has been run at an exceptionally high velocity, which, however, was maintained for a short time only.

Such tests have not been productive of any change in operative methods, though they have shown that a train would run safely on a good track at speeds considerably above those customary, and they indicated that the power required was less than had been supposed. In such tests the locomotive is limited by the steaming capacity of its boiler, which in our present designs is not great enough to supply the heavy demands made by the engine. This is the difficulty standing in the way of any great decrease in the speed of steam-drawn trains. It is known that the track and the cars will stand the strain and the engine can safely make the necessary number of revolutions per minute, but for this it requires more steam than the boiler can supply and it is difficult, if not impossible, to increase the boiler capacity to any extent.

This limiting factor is not present in an electrically operated train and the possibility of thus obtaining a greatly increased speed was recognized as soon as the success of the electrically operated street car had been demonstrated. In this case the supply of power is limited only by the power of the station, which can be increased indefinitely, and by the current which can be collected from the working conductors. The speed then depends upon the

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size of the motors and the track construction. A number of attempts have been made to see what could be done in this direction in some peculiar track construction being resorted to. It will, however, be sufficient to take up the first and the last instances.

About 1866, a company known as the Electro-Automatic Railway Company, was organized in Baltimore, Md., to develop a high speed automatic parcel express between large cities. An experimental track, circular in shape and about two miles in circumference, was constructed at Laurel, Md. The gauge was 28 inches, the weight of rails 16 pounds to the yard. Wooden guard rails were laid alongside the running rails and a vertical framework on both sides of the track supported by means of a wooden stringer a light third rail, head down, over the centre of the track. This served as the working conductor and it was thought would hold the car on the track. In this latter duty it failed, and the whole track construction was found to be far too light for the purpose for which it was intended. Current was returned through the track rails.

The car was a steel box, 16 feet long, 24 inches high and 30 inches wide, with pyramidal ends. It was mounted on three axles with 28 inch wheels, and on each axle was placed a 20 horse-power direct current motor. Later the central motor was taken off. The car weighed complete, three tons, and the motors were designed for a speed of 3,000 revolutions per minute, which would give a car speed of 250 miles per hour.

The road was tested in the fall of 1889. Speeds up to 115 miles per hour were obtained, but it was found impossible to keep the car on the track when moving at high velocities. On the last test it left the track when moving with a speed of 115 miles per hour, wrecking the car and 1,000 feet of the track. With a track at all suited to the work, the car could have maintained a speed of 120 miles per hour indefinitely. The engineer in charge of the test advised building a heavier track and car, but as the necessary money was not available the work was stopped.

The tests, while not giving much data, served to show that the train resistance formulæ then in use were not applicable to high speeds. For fuller information, consult report of 'High Speed Electric Railway Work,' by O. T. Crosby; Transactions of the American Institute of Electrical Engineers (Vol. VIII., 1890-1).

The latest tests of importance are those begun in 1901 on a 14 mile stretch of track between Marienfeld and Zossen, near Berlin, Germany. The road is nearly straight, with slight grades. The track was first laid with 70 pound rails on iron ties, but this proved unable to stand high speeds and was relaid with 92 pound rails on iron chairs, spiked to wooden ties. The old rails were laid as guard rails on the inside, but from later tests this precaution seems to have been unnecessary. The track is ballasted with broken basalt. Over this track a car mounted on two three-wheel trucks, each truck equipped with two 250 horse-power three-phase motors, was run at various times at increasing speeds until on 6 Oct. 1903, a speed of 126 miles per hour was reached. Later in the month higher speeds, in one case a little over 130

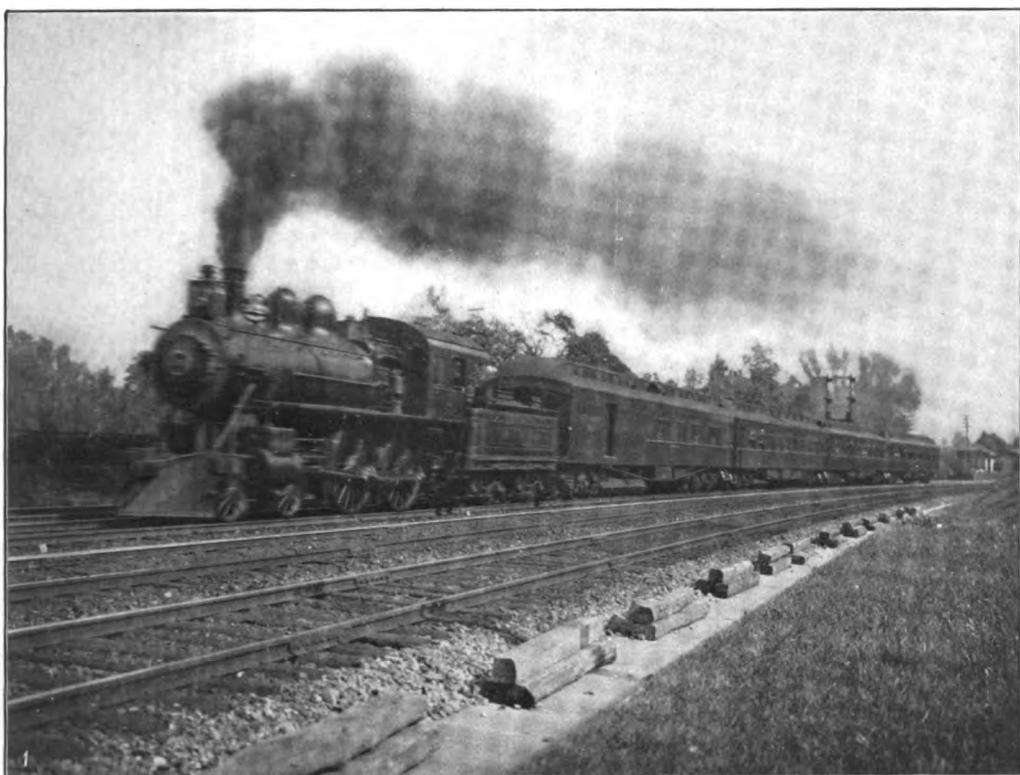
miles per hour, were reached, but unofficially. The car carried a number of observers and ran quite smoothly. The curve was taken at a somewhat reduced speed. During the fastest runs about 1,000 horse-power was developed by the four motors.

The car weighed about 100 tons. The motors are supplied with current at from 1,150 to 1,850 volts from transformers on the car, which reduce the line voltage from 14,000. Current was collected from three line wires by means of two sets of bow contacts. The complete data and computed results of these tests have not yet been made public (March 1904), but the success of the experiments has induced a number of German steam railroads to plan for higher speeds on their existing tracks. In the United States, the New York Central Railway, acting with the General Electric Company, is planning to carry out a similar investigation, and will, if possible, exceed the German speeds. The German tests demonstrated the safety of trains at 125 miles per hour on a straight well-laid track and showed that the requisite power could be collected without difficulty. It is evident that such speeds can be allowed only on a road having no grade crossings, and a change in signaling methods will be necessary to enable the engineer to bring his train under control within the block. The probable financial success of such high speed lines may properly be questioned. No doubt they would carry much, if not all, of the long distance traffic. For short distances they are not feasible. They will be expensive to operate and will probably not greatly increase the present traffic. However, the tendency is toward higher speeds and eventually the public demand will bring it about.

WM. HAND BROWNE, JR.,
'*Electrical Review*,' New York.

Railways, Inclined and Mountain. Inclined and mountain railways are similar in their object—the ascension of heights by railway carriages; but the term, "inclined railway," is commonly applied to a line of rails and cars supported on or against the steep side of an elevation, and used to carry passengers and also live stock and vehicles to and from the top of the elevation. Such are the inclined railways on the south side of the Monongahela River at Pittsburgh, and on the New Jersey side of the Hudson River, opposite New York. The inclined railway is one of the devices for facilitating travel in and about cities, and bears about the same relation to a mountain railway that a ferry-boat does to a coastwise steamship. It can be propelled by cable, with steam as the motive power, or by electricity. The use of the inclined railway is not as general as might be expected, considering the extensive tracts of land in the vicinity of New York and other cities which the inclined railway would make readily accessible.

The mountain railway is of American origin, but other countries quickly adopted a means so obviously useful in making mountain travel comparatively safe and comfortable for traveler and tourist. The first mountain railway was opened at Mauch Chunk, Pa., in May 1827. It was first used to draw coals from the mines to the Lehigh River, the cars descending by gravity, and being returned by mules. A stationary engine on the summit has taken the place of the



1. The Pennsylvania Special.
2. The Twentieth Century Limited Speeding a Mile in 35 Seconds.

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mules, and the train is now used only by tourists. The Mount Washington Railway, in the White Mountains, N. H., opened in 1869, is very steep, and has a grade in places of one foot in three. The track is of three rails, bolted to a heavy timber trestle, the cogwheel which draws the train running up the centre rail. The seats are suspended so as to swing horizontally. The Otis Elevating Railway, in the Catskills, has an incline 7,000 feet in length with a rise of 1,000 feet.

In the Western United States, also, are some celebrated mountain railways, including the road from Manitou to the summit of Pike's Peak, Colo., eight miles long, and ascending 14,146 feet. The aerial railway over the Chilkoot Pass to Lake Linderman, Alaska, completed early in 1898, shortened the time from tidewater to the headwaters of the Yukon River from a month to a day, and greatly reduced the hardships of a journey to the mines.

Switzerland presents some fine examples of mountain railways. The electric railway to the summit of the Jungfrau (13,670 feet), constructed in 1903 and 1904, is a triumph of modern engineering. The greater part of the way is underground, and galleries are cut at each station to allow passengers to obtain views of the magnificent scenery. The average gradient is 17 per cent, the maximum being 25 per cent. The gauge of the track is 39 inches, the weight of the rails is 42 pounds per yard, and these are bonded and cross-bonded. The sleepers are of steel of the usual continental type, and the rails are fixed by means of bolts and clamps. The journey to the top occupies about one hour and forty minutes, which enables the passengers to accustom themselves to the altered conditions of the atmosphere. At the terminus station the passenger may ascend to the summit of the great mountain, with its dazzling shroud of eternal snow, either by a lift 242 feet high, or by a winding staircase on the outside.

Another interesting mountain railway is that which circles Mount Etna in Sicily. Twenty-two miles of cutting had to be made through lava as hard as granite, and the line, which is only 70 miles long, required four years to complete. It passes through a flourishing region and also scenes of former havoc by volcanic eruptions, and is much appreciated by tourists.

Railways, Laws Affecting. See CARRIER, COMMON.

Railways, Suspended. See SUSPENSION RAILWAYS.

Railways, Underground. See SUBWAYS.

Raimond, ră'mônd, C. E. See PARKES, ELIZABETH ROBINS.

Raimondi, ri-môn'dē, Marco Antonio (MARKANTON), Italian copper-plate engraver: b. Bologna about 1488. He acquired the goldsmith's art in France and was especially successful in niello, but finally gave all his attention to engraving on copper. In 1505 he went to Venice and attracted attention by his copy on metal plate of Dürer's 'Life of the Virgin.' He was later attracted to Rome, where Raphael soon selected him as the engraver of his pictures. After Raphael's death Giulio Romano commissioned him to make plates from 20 of his best paintings, but having reproduced some licentious designs of that artist, Pope Clement VII. or-

dered the plates to be destroyed by the public executioner and Raimondi was cast into prison. He was released through the intercession of the sculptor Bandinelli, and to show his gratitude Raimondi made a copy in line engraving of Bandinelli's 'Martyrdom of Saint Lawrence.' Losing his property in the sack of Rome (1527) he returned to Bologna where all traces of him are lost. The value of his engravings after Raphael lies in the fact that they were executed under that artist's eye, and were many of them copies, not of completed pictures, but of rough draughts and tentative designs, which but for these copper-plate reproductions would have been lost to the world. Being thus brought in intimate relation with the painter's methods, he became the best interpreter of Raphael in black and white, and no engraver has so completely entered into the spirit and power of expression which breathe in the canvases of the greatest Italian painter. His best engravings after Raphael include 'Adam and Eve'; 'God Commands Noah to Build the Ark'; 'The Massacre of the Innocents'; 'Mary with the Dead Christ'; 'The Judgment of Paris'; 'The Three Doctors of the Church.' Consult: Delaborde, 'Marc-Antoine Raimondi' (1887).

Raimund de Sabunde, ri'moond dā sā-boon'dā, scholastic philosopher: b. Barcelona. In 1436 he appears at Toulouse as a teacher of medicine, philosophy, and theology, and he labored especially to reconcile the apparent contradictions between nature or reason and the Bible; an undertaking which led him into the realm of mysticism. In his 'Liber Creaturarum seu Theologiæ Naturalis' he applied this principle so as practically to reconstruct the whole system of Church doctrine. He and his system have been discussed by Matzke (1846); Huttler (1851); and F. Nitzsch in the 'Zeitschrift für historische Theologie' (1859).

Rain, water dropping through the atmosphere. A mass of air in the atmosphere always contains some aqueous vapor, and if this air is cooled below a certain temperature, called the dew-point (which depends on the amount of vapor present), the vapor will condense into drops of water. This cooling may be due to radiation of heat to colder regions, or to mixture with colder masses of air. When air rises in the atmosphere to colder regions, or comes in contact with a cold part of the earth, or passes from equatorial to polar parts of the earth, its moisture tends to condense into rain. In considering the probable rainfall of a place we are concerned with its latitude, its elevation above the sea, its proximity to the sea, the laws affecting its seasonable variations, the prevailing winds, and the configuration of the surrounding surface. Low latitudes have in general a heavy rainfall, because of the greater evaporation in tropical regions, and the consequent formation of rain when the clouds due to evaporation get colder in the higher regions of the atmosphere. Hence also winds blowing from the equator are generally moist, and winds blowing to the equator are generally dry. The presence of forests tends to increase the rainfall (see METEOROLOGY), and the rain further encourages vegetation. The influence of the seasons on rainfall is pretty regular in the tropics. Over the ocean the skies are clear where the trade-winds are blowing steadily, and heavy rain falls by day in the zone

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of calms; on land there is a regular alternation of dry and wet seasons. Toward the equator, where there is a considerable interval between the two passages of the sun across the zenith, there are two rainy seasons. In monsoon regions, however, the alternation of dry and wet seasons depends on the winds. Beyond the tropics we have variable winds and variable rainfall. The following table gives recent figures for the mean annual rainfall of a number of stations in various parts of the world:

	Inches		Inches
Greytown (Nicaragua)	260	Perth (Australia) .. St. John (New Brunswick) ..	32
Freetown (Sierra Leone)	125.8	Ottawa	31.75
Rangoon	99	Rome	31.4
Bahia	95.1	Berlin	30.6
Batum	93	Liverpool	29.98
Rockingham Bay (Queensland) ..	90	Dublin	29.01
Colombo	88	Edinburgh	28.4
Astoria (Oregon) ..	86.3	Algiers	28.32
Saigon	82.96	Charlottetown ..	26.72
Nagasaki	77.6	Melbourne	26.71
Bergen (Norway) ..	73	Smyrna	26.6
Batavia	71.4	Cape Town	25.63
Bombay	70.3	London	25.01
Vera Cruz	67.9	San Francisco ..	25
Calcutta	65.6	Vienna	24.08
Tokyo	60.4	Nairn	23.42
Manila	55.2	Bathurst	23.3
New Orleans	55.17	Mexico	22.9
St. John's (Newfoundland) ..	52.9	Bloemfontein ..	21.29
Brisbane	52.36	Moscow	21.1
Sydney	49.86	Upsala	21.1
Madras	48.69	Lahore	21
Havana	46.5	Adelaide	20.25
Quebec	46.07	Winnipeg	20.12
Glasgow	45.4	Marseilles	20.08
Halifax	45.34	Paris	19.68
(Nova Scotia) ..	44.76	St. Petersburg ..	18.8
Auckland	43.62	Tobolsk	18.6
St. Louis	40.69	Kimberley	18.26
Durban	39.48	Irkutsk	16.5
Montreal	39.28	Denver	14.9
Bogota	39	Santiago (Chile) ..	14.1
Pietermaritzburg ..	38	Odessa	14
Chicago	37.57	Yakutsk	13.7
Kingston (Jamaica) ..	35.79	Valparaiso	13.5
Toronto	34.4	Vladivostok	13.2
Buenos Ayres	34.1	North Cape	10
Belfast	34	Regina	8.38
		Okhotsk	7.5
		Yuma (Arizona) ..	2.9
		Cairo	1.34
		Walfisch Bay	.3

It has been proven that rain has a most cleansing effect on the atmosphere, a five days' rainfall in London, England, having carried off not less than 3,738 tons of solid impurities, including 267 tons of sulphate of ammonia, and 2,000 tons of soot and suspended matters.

Rain-birds, various birds so called because of their observed or supposed connection with rains or the foretelling of wet weather. The cuckoos seem to be most widely credited with foreknowledge of storms, as they are in the habit of calling most noisily at such times. Thus the yellow-billed cuckoo (see Cuckoo) is called "rain-crow" in the Southern and Western States. Further Southwest, and in Mexico and Central America, the name is given to the anis (q.v.); while in the West Indies two or three other cuckoos are so termed. These are familiar species of the genera *Saunderothra*, *Hyetorhis*, and *Piaya*, the last named extending over most of the Andean region. The rainbird of India is a quail (*Coturnix Coromandelica*), which recalls one of the names, "wet-my-lip" of the American eastern quail; and that of the Malay region is one of the broadbills (*Cymborynchus*). In England the green woodpecker

is called "rain-bird"; and in the Orkney Islands one, the loons, especially the red-necked, is known as "rain-goose." The prophetic power of the birds is exaggerated in popular estimation; but probably they do somewhat perceive a coming change of weather, especially of increased moisture, and those, like the above mentioned, which are, naturally noisy, do then call more loudly and frequently than usual.

Rain-gauge, or **Pluviometer**, an instrument which measures the depth of the rainfall at any place. In its commonest form it consists of a cylindric vessel closed at the top by a funnel-shaped lid, through a hole in the centre of which the rain falls. A narrow glass tube, rising outside the vessel from near the bottom, shows by the height of the water in it the height of the water in the vessel itself. A very simple rain-gauge consists of a copper funnel, the area of whose opening is exactly 10 square inches. This funnel allows the rain to pass into a bottle, and the quantity of rain caught is ascertained by multiplying the weight in ounces by 0.173, which gives the depth in inches. As a rain-gauge is nearer the ground it is found to indicate a greater rainfall. This is partly due to the cold rain-drops getting larger in falling through the very moist air near the ground, and partly to the greater occurrence of eddies about the gauge at greater heights. Hence, when the rainfall at two places is to be compared, the gauges ought to be similarly situated. A rain-gauge must be placed in as open a position as possible, out of the way of houses, trees, and similar objects.

Rain-making. The subject of rain-making, or bringing rain from the clouds in a season of drought, has in all ages been of the greatest interest to humanity, as lack of rain has caused many famines and the loss of many millions of lives. Attempts have been made to bring rain by appeals to Divine Providence in prayer in Christian countries, while the ignorant heathen practise various forms of fetishism, and even offer up human sacrifices with the same object. Owing to the large extent of arid lands in the United States the question of bringing about rain by scientific processes has engaged attention for many years past. It was noted that forest fires have often been followed by rain, and in 1834 James P. Espy, of Pennsylvania, proposed the building of enormous fires in the regions where rain was desired, to bring about the needed showers. This was regarded as impracticable both in America and in Australia where it was also suggested. That great battles, and sometimes lesser ones, attended by cannonading, were occasionally followed by heavy rainfalls is a historic fact, and this gave origin to the belief that explosions similar to those of artillery might bring about rain in a season of drought. This belief did not apparently take into account the circumstance that important battles are usually fought in temperate regions, with normal rainfall, and where a disturbance of the atmosphere might easily bring a downpour from the skies. It is also averred by the opponents of this theory that the number of battles followed by rain has been comparatively small. In 1891, however, Congress made an appropriation for a series of experiments in Texas, which were conducted by

RAIN-TREE — RAINBOW

Gen. Dyrenforth for the Department of Agriculture. There has been much controversy as to the effect of these experiments which were conducted on the theory of provoking rainfall by concussion caused by explosions, giant powder being the explosive used. Gen. Dyrenforth claimed that the experiments were entirely successful, that the drops sometimes commenced to fall within 12 seconds after the initial explosion, and that "the concussions from explosions exert a marked and practical effect upon the atmospheric conditions, in producing or occasioning rainfall, probably by disturbing the upper currents." On the other hand, Prof. A. H. Hazen, basing his views on the newspaper reports of the experiments, argued that there was no evidence whatever that any rainfall had been produced by the explosions, while W. K. Curtis, M.D., who was with the Dyrenforth party, substantially confirmed Prof. Hazen's view, and declared that rain fell before the experiments had begun. The weight of evidence was generally accepted by the public as supporting the views of Hazen and Curtis, and while the theory that rain frequently follows aerial explosions has not been abandoned, no serious efforts have been made to follow up the experiments of Gen. Dyrenforth. See METEOROLOGY.

Rain-tree, a leguminous tree (*Pithecolobium saman*) of tropical America, now largely planted in India for the shade it furnishes, and because it flourishes in barren salt-impregnated soils, as well as for its sweet pulpy twisted pods, which are greedily eaten by cattle. Another species (*P. dulce*) with edible pods is a native of Mexico, but has been introduced into the Philippine Islands and also into India.

Rainbow. The rainbow is the best known of all optical meteorological phenomena, consisting of a colored arch formed opposite the sun on falling raindrops, and visible whenever the necessary conditions of a passing shower on one side and a clear and not too high sun on the other occur. Two bows are frequently seen, each exhibiting the full spectrum of colors from red to violet; but in the inner or primary bow the red is the outer edge and violet the inner, while in the outer or secondary bow the order is reversed, the red being inside and the violet on the exterior. The colors are always arranged in a definite order, that of the solar spectrum, — namely, red, orange, yellow, green, blue, indigo, and violet, but shade imperceptibly into each other. The cause of this breaking up of the sunlight into its constituent colors is explained in most physical and meteorological text-books, but may be briefly summarized as follows:

For the primary bow (Fig. 1), let PQR represent the section of a raindrop, and SP a ray of light falling on it. The ray enters the drop at P, meets the surface again at R, is reflected to Q, where it leaves the drop in the direction of QE. The ray is refracted or bent on entering the drop at P and again on emerging at Q — the amount of this refraction depending on the acuteness of the angle at which the ray meets the surface. Now it may be shown that there is a particular point P, such that any ray from S striking the surface below P emerges again above Q, and any ray above P also emerges above Q — the former owing to the more acute angle of the reflection, and the latter to the greater refraction on entering and leaving the

drop. The course of two such rays is shown by the dotted lines in Fig. 1. Q is thus a turning-point in the emerging rays, and near it a

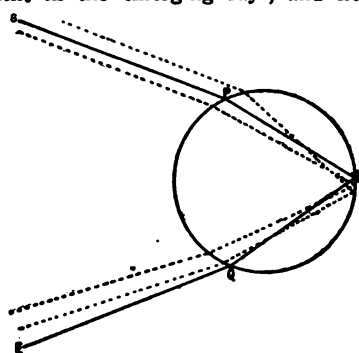


FIG. 1.

very large number of rays pass out, and an observer at E sees a bright image of S in the direction EQ. This statement applies to any one color of sunlight; but, as the refrangibility increases from red to violet, the latter is bent more at P and Q, and the line EQ lies at a flatter angle. The observer, therefore, sees the violet rays reflected on drops at a less altitude than those that reflect the red, the other colors being intermediate. The raindrop being spherical, this reflection takes place in all directions, the fixed condition being the radius of the bow, that is the angle between the line from the observer to the bow and that passing from the sun to the observer, or, in other words, the observer's shadow. For red light this angle is $42^{\circ} 39'$, and for violet $40^{\circ} 13'$. If the sun were a luminous point each color would be sharply defined, but as the disk of the sun subtends an angle of about $30'$ each color is broadened to this amount, and they overlap.

Exactly similar reasoning explains the secondary bow (Fig. 2). The light that forms it

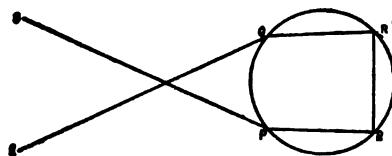


FIG. 2.

has been twice reflected, at R and at R'; the point Q lies above P, and rays entering either above or below P all emerge below Q. A glance at the diagram will show that the greater bending of the more refrangible rays makes the line EQ more nearly vertical, and therefore the violet rays form the outer edge and the red the inner of the secondary bow. The radius of the red is $50^{\circ} 5'$, and of the violet $54^{\circ} 0'$. The space between the bows gets no reflected light, but that inside the primary and outside the secondary is faintly illuminated by rays such as are indicated by the dotted lines in Fig. 1 and their equivalents in Fig. 2, which are not shown. These rays "interfere" with each other, and cause alternations of color which appear as spurious bows inside the primary and outside the secondary. They can only be seen with strong sunlight and small drops of rain.

The radius of the primary bow being roughly

RAINBOW FALLS — RAINSFORD

40°, it is evident that it cannot be seen when the sun is at a greater elevation than this, as the highest part of the bow would lie below the horizon. See LIGHT.

Rainbow Falls. See CHELAN, LAKE.

Rainbow Trout, a fresh-water fish (*Salmo irideus*) indigenous to the mountain streams and rivers of the Pacific coast of the United States, but widely introduced into eastern waters. From the eastern brook-trout (*Salvelinus fontinalis*) it may be easily distinguished by its colors and the presence of teeth on the vomer bone; from the related salmon trouts, with some difficulty, by its small mouth, and the number of scales, about 135 in typical examples, along the lateral line. The rainbow trout is exceedingly variable and many distinct forms, which are considered by ichthyologists to be modifications of this species but which have received distinct vernacular names, are found occupying particular streams or watersheds. The complex relations of the various species of trout and salmon to their environment is little understood. From fish-culturists the McCloud River trout (*S. irideus shasta*) has received much attention since 1880. This variety is particularly well adapted for stocking streams and ponds in which the brook-trout no longer thrives owing to the clearing of the forests and the resulting higher temperature and increased muddiness of the water. To supply the great and constant demand for young fish for stocking purposes the Federal Fish Commission maintains several large hatcheries and many States others. Carefully selected breeding fish are kept in specially constructed ponds designed with reference to cleanliness, good circulation, and ease of handling the fish. Spawning occurs during the winter. The ripe females are stripped in the usual way and the eggs mixed with the milt in a pan either with or without water. After a few minutes water is added and they are gently agitated and repeatedly washed to remove the surplus sperm, and, after standing about an hour, are transferred to the hatching trays, which are constructed of galvanized wire. These trays are arranged in troughs with running water in such a way that the young fry fall into the latter as they hatch. As the fry grow and begin to feed they are distributed to other troughs and finally to rearing ponds constructed in a manner to insure cleanliness and an abundance of flowing water. The young are fed on ground liver and are transplanted when several months old. They grow rapidly, but in the East never attain the large size which they do in their native streams. They feed on insect larvæ, etc., and may be fed artificially on chopped beef or liver mixed with corn meal. For angling purposes the rainbow is inferior to the brook-trout, but is a fair substitute.

Raines, John, politician: b. Canandaigua, N. Y., 6 May 1840; d. 22 Feb. 1909. He was graduated from the Albany Law School in 1861, and admitted to the bar. He served in the Civil War as captain from 1861 to 1863; then began his law practice. He was a Republican member of the New York Assembly in 1881-2, and again in 1885; of Congress in 1889-93; and of the State Senate in 1886-9, and 1895-99. In 1903-4 he was president *pro tem.* of the Senate and chairman of the committee on rules. He is best known as the author of the Raines

Liquor Law (q.v.), and he also framed the State election law.

Raines' Law, so called from State Senator John Raines, who introduced the measure, a law passed in 1896 by the legislature of New York, and since amended in several particulars, but always retaining the essential features of State control of the liquor traffic, and high license for cities, the present full license under the amendments of 1903 being \$1,200 in the old city of New York, and \$800 in the borough of Brooklyn. The law permits hotels to sell to guests on Sunday, and this has led to the establishment of numerous places known as "Raines' Law Hotels," which comply with the strict letter of hotel regulations, but do what is chiefly a liquor saloon business. The law has been very profitable in its operation both for city and State, the city receiving two thirds and the State one third of the net income from licenses. In the year ending 30 April 1903 the net receipts were \$7,991,865.39 in New York city, as against \$1,736,918.43, the last year of the old excise law in all the municipalities which now constitute the city.

Rainier, rā'nēr, Mount, a peak in the State of Washington, belonging to the Cascade Range, 14,520 feet above sea-level and about 10,000 feet above the surrounding land. It is near Puget Sound, east of Tacoma, and it is sometimes called Tacoma. It is of volcanic origin, cone shaped; its crater still sends out volcanic gases, but it is classed with the extinct volcanoes. The eroded slopes indicate there has been no eruption for hundreds of years. The base and the lower slope are covered with forests, but the summit is snow-capped. There are a number of glaciers on the summit. The first ascent of the mountain was made in 1870. In 1897 it was ascended and quite thoroughly explored by a large party. See ROCKY MOUNTAINS.

Rains, George Washington, American military officer: b. Craven County, N. C., 1817; d. Newburgh, N. Y., 21 March 1898. He was graduated from West Point in 1842, served in the engineering corps, was transferred to the artillery, and in 1844-6 was assistant professor of chemistry, mineralogy, and geology at West Point. He served on the staffs of Gens. Scott and Pillar in the Mexican War, and received brevet rank of major, was active in the Seminole War, and in 1856 he resigned from the army and engaged in business. At the outbreak of the Civil War he entered the Confederate service, was commissioned a colonel and placed in charge of the building and equipment of a powder mill at Augusta, Ga., where he remained until the end of the war, receiving promotion to the rank of brigadier-general. In 1867 he became professor of chemistry and pharmacy in the University of Georgia, and was dean of the faculty there till 1884. He was interested in mechanics, and secured several patents on his inventions for improvements for steam-engines. He wrote: 'Steam Portable Engines' (1860); 'Rudimentary Course of Analytical and Applied Chemistry' (1872); 'History of the Confederate Powder Works' (1882); etc.

Rains'ford, William Stephen, American Episcopal clergyman: b. Dublin, Ireland, 30 Oct. 1850. He was graduated from Saint John's College, Cambridge, in 1872, took orders in the

RAINY — RAJA

English Church, and in 1873-6 was curate at Saint Giles', Norwich, England. In 1876 he came to the United States and engaged in evangelistic services in New York. He was assistant rector at Saint James Cathedral, Toronto, 1876-83, and in the last named year became rector of Saint George's Church, New York but resigned in 1906. Under his management the work of the parish was greatly extended and many societies and missions were established in connection with it. He is widely known as an earnest, fearless, and eloquent preacher. He has published: 'Sermons Preached in Saint George's'; 'Reasonableness of Faith' (1902); 'A Preacher's Story of His Work' (1904), etc.

Rainy, Robert, Scottish Presbyterian clergyman: b. Glasgow, Scotland, 1 Jan. 1826; d. 22 Dec. 1906. He was educated at the University of Glasgow, held various important pastorates in the Free Church, was professor of church history at New College, Edinburgh, in 1862-1900, and from 1874 was principal there. He published: 'Life of Principal Cunningham' (1871); 'The Bible and Criticism' (1878); 'The Ancient Catholic Church' (1901); etc.

Rainy Lake, Canada, between Lakes Superior and Winnipeg, forms part of the boundary between Canada and the United States. It is about 40 miles long by 15 miles broad, receives the waters of numerous small lakes from the east and northeast, and empties itself by Rainy River, about 90 miles long, into the Lake of the Woods.

Raised Beaches. See BEACHES, RAISED.

Raisin, the commercial name for the dried or cured grape. In Europe the raisin product comes largely from Italy and France, and in the United States almost wholly from California. See RAISIN INDUSTRY, THE.

Raisin Industry, The American, is confined almost wholly to California. The raisin crop comes from the great San Joaquin Valley and from several counties in southern California. The headquarters of the industry are about Fresno. The California raisin grape culture began to be of commercial importance in 1874, when the output was 9,000 boxes, or 180,000 pounds of raisins. The industry advanced "by leaps and bounds" up to 1894, when the crop amounted to 103,000,000 pounds—figures which have never since been exceeded, or even equaled. The markets "broke" under this great output, and the crop sold for less than 2 cents per pound. As a result there was a sharp decline both in the acreage and in the output of raisins during the next four or five years. However, the growers protected themselves and their market by forming, in 1898, a Raisin Growers' Association, which controlled about 90 per cent of the yield. This association still continues to handle the bulk of the raisin crop, and has been quite successful in distributing to the best advantage the large output in the different markets. Last year (1902) the California raisin crop amounted to 100,000,000 pounds. The standard box of raisins weighs 20 pounds, and contains four layers of five pounds each. The raisins are packed and graded into layers, and one, two and three crown loose. The processes of curing, seeding, and packing raisins have been improved from time to time, and to-day

machines do much of the work formerly done by hand. The first great device was a patent seeder, and the latest one is a raisin-packing machine, by which the packages, or cartons, are filled, weighed and sealed.

The leading varieties of grapes used for raisins are: Muscatel, Gordo Blanco, Muscat of Alexandria, and Malaga; for seedless raisins, Sultana and Thompson's Seedless. Grapes are ripe by the middle of August, and the season often lasts into November. The average time of drying and curing a tray of raisins is about three weeks, all depending on the weather. The earliest picked grapes dry in ten days, and the later ones often take four weeks and even more. The method of drying is very simple. The bunches are cut from the vines and placed on shallow trays two feet wide, three feet long, and one inch high, on which the grapes are allowed to sun-dry, being turned from time to time by simply placing an empty tray top side down on the full one, then turning both over, and taking off the top tray. After the raisins are dried they are stored away in the sweat boxes until they are packed and prepared for shipment. Some of the larger growers, in order not to run so much risk in drying on account of rain, and also to enable them to handle the crop fast enough, have curing houses, where the curing is finished after having been partially done outside. The seeding, grading, packing, and shipping have become separate branches. In the season of 1901-2 some 60 plants, most of them located in the Fresno district, were engaged in this part of the work. These establishments furnished employment for 5,000 employees, and the aggregate wages paid out to them each month during the season was nearly \$250,000.

The exports of California raisins first became of sufficient importance to be separately stated in the official reports of the treasury department in the fiscal year ending June, 1892. Raisins were first sent in small quantities to all parts of the world, but the trade has grown quite rapidly. In 1898 the exports amounted to 3,109,639 pounds, and in 1902 to 2,323,274 pounds.

The following figures serve to show how the foreign raisin trade has fallen off, and how California raisins have monopolized the markets of this country:

RAISINS PRODUCED AND IMPORTED.

Year	Raisins produced Pounds	Raisins imported Pounds
1885	9,400,000	53,702,220
1890	38,000,000	36,914,330
1895	91,360,000	15,921,278
1898	80,631,000	6,593,833
1902	100,000,000	6,563,302

See also GRAPE CULTURE.

LEE J. VANCE,

Editor of the 'American Wine Press.'

Raisin River, Battle of. See MONROE, MICH.

Raja, rā'jā, or **Rajah**, a title of hereditary princes of the Hindus. Before the subjugation of the country by the Moguls the various countries of Hindustan were governed by rajas, who belonged to the Kshatriyas or military caste. They were sometimes independent rulers and again feudatory, and the highest title, "Maharaja," was given to those who controlled other sovereigns. The title is now usually merely

RAJAMANDRY — RÁKÓCZY

honorary and is not confined to any caste, while those retaining some degree of actual authority under the British are now designated "Maharaja." Consult: Foy, 'Die königliche Gewalt nach den altindischen Rechtsbüchern' (1895); Jolly, 'Recht und Sitte' (1896).

Rajamandry, rā-jā-mān'drē, or **Rajamahendri**, India, a town of the Godavari district, Madras, on the east bank of the Godavari (here three miles wide), 30 miles from the sea. Among buildings and institutions are the court-house and judge's residence, churches, mission of the American Evangelical Lutheran Church, provincial college, several schools, museum, dispensary, public garden, and large prison. Pop. 28,500.

Rajmahal, rāj-mā-hāl', India, on an eminence overlooking the Ganges, 170 miles northwest of Calcutta, for many years ranked first among the towns of the Bengal and Bahar provinces. It is now noteworthy only for its palatial ruins, and as a station in an important transit trade.

Rajon, rā-zhôn, **Paul Adolphe**, French etcher: b. Dijon 1842; d. Auvers 8 June 1888. He was trained at the Ecole des Beaux Arts at Paris, and in 1865 produced his first etching after Meissonnier's 'Rembrandt at Work.' His many subsequent works won for him the leading position among French etchers, and on visiting England in 1872 he found his reputation had preceded him and was commissioned to make an etched copy of John Stuart Mill's portrait by George Frederick Watts, and of Tennyson's portrait by the same painter. He was eminently successful in these and other portrait etchings, but his most ambitious and brilliant work was 'The Emperor Claudius' after Alma Tadema.

Rajputana, rāj-poo-tā'na, India, a western political division, extending from the Jamna and Chambal rivers, west to Sind and Bhawalpur, and comprising the greater part of the Indian Desert. It consists of a number of native states controlled by the British assistant political agencies of Mewar, Jaipur, Marwar, Haraoti, Eastern States Agency, Alwar, and Sirohi; together with the British enclave of Ajmir-Merwara. The total area of the native states is 127,541 English square miles; or including the British district of Ajmir-Merwara 130,252 square miles. The maharajas and rajas are supreme in their own states, and settle disputes among themselves in courts of their own. A great portion of the surface of Rajputana is desert, and part of it wholly destitute of inhabitants, water, and vegetation. The whole of the soil is remarkably saline, containing many salt springs and salt lakes, and much of the well-water is brackish. The rainfall is scanty, and the region frequently suffers from famine. In many places it is covered with the cactus and other prickly shrubs; except in the Aravalli Hills which traverse the region from southwest to northeast, the territory is almost destitute of trees. Where practicable, pastoral and agricultural pursuits occupy the people. Conditions have slightly improved since British enterprise has opened up the country by a transversal line of railroad, with diverging branches, connecting with the rest of the Peninsular railway system. The chief town is Jaipur, other urban

centres are Bikanir, Jodhpur, Bhartpur, Udaipur, and Tonk. While the chiefs are of Rajput origin, the Rajput element is in the minority among the population, which consists chiefly of Hindus, with Mohammedans, Animists, and Jains. Pop. (1891) 11,990,504; (1901) 9,723,301, showing a decrease in the decade of 2,267,203, mainly due to the famine of 1899-1900.

Rajputs, rāj-poots', a people of India, giving their name to Rajputana (q.v.), and said to be a branch of the Kshatriyas, one of the four great castes into which the Hindus were originally divided. They are essentially a military people, and many of their institutions bear a strong resemblance to the feudal customs which prevailed in Europe in the Middle Ages. They are celebrated for their chivalrous spirit in marked contrast to the usual effeminacy and duplicity of many of the Oriental nations. The practice of female infanticide, however, at one time was prevalent among them, until suppressed by British influence; the profuse use of opium has likewise in many cases produced a lamentable deterioration in their physical and moral state. Notwithstanding these drawbacks the Rajput character contains much that is noble and generous. The Rajputs became first connected with the British government under the governorship of the Marquis of Wellesley, in the beginning of the 19th century. Besides Rajputana, the Rajputs are numerous in Sind and Guzerat.

Rájsháhi, rāj-shā'hē, India, a division or commissionership of Bengal, extending from the Ganges to Sikkim and Bhutan. Area, 17,351 square miles; pop. (1901) 8,489,788. The district of Rájsháhi, forming part of the division, has an area of 2,330 square miles; a population of about 1,400,000. The capital of the division and district is Rámpur Bealeah.

Rákóczy, rākōt-sē, a Transylvanian princely family now extinct in the male line. They were for some time rulers of the principality of Siebenbürgen, or Transylvania, and by a rigorous maintenance of the civil and religious rights of the inhabitants made their influence over their subjects such as to render them formidable to the power of the royal house of Austria. The first prince of the name was SIGISMUND RÁKÓCZY, who obtained the government in 1606, but abdicated in favor of Gabriel Bathori in 1608. His son, GEORGE RÁKÓCZY (b. 1591; d. 24 Oct. 1648), assumed the sovereignty in 1629 and regained for his subjects many lost privileges. He was succeeded by his son, GEORGE II. (b. 1615; d. 8 July 1676), who attempted an invasion of Poland, was defeated and forced to abdicate, but regained his authority. He died after having been again forced to resign. His son, Francis I., never reigned, but was implicated in various political complications and the last of the family to hold sovereign power was his grandson, Francis II. (q.v.).

Rákóczy, Francis II., Transylvanian prince: b. 27 March 1676; d. Rodosto, Turkey, 8 April 1735. His attempt to free his country from Austrian rule resulted in his being sentenced to death for high treason, but he contrived to escape, rallied the Hungarians to his support and was proclaimed protector. The alliance of certain of the Hungarian states with Austria afterward caused his defeat and he resigned his

RAKOCZY MARCH—RALEIGH

estates and went to Turkey. He wrote: '*Mémoires sur les Révolutions de Hongrie*' (1738).

Rakoczy March, the name of a Hungarian military air by an unknown composer of the 17th century, said to have been the favorite march of Francis Rakoczy II. of Transylvania. See NATIONAL HYMNS.

Rale, *räl* (spelled also incorrectly, *RASLE*, *RASLES*, and *RALLE*), **Sebastien**, French Jesuit missionary in North America: b. Franche-Comté 1657; d. Norridgewock, Maine, 12 Aug. 1724. In 1675 he became a Jesuit novice at Dôle, in 1677-84 was an instructor at Carpentras and Nîmes, and in 1689 was sent to the American missions. For two years he was among the Abenakis near the mouth of the Chaudière in the mission of Saint Francis. Then he passed two years among the Illinois, and finally was placed in charge of the Abenakis of Kennebec. He was believed by the English to be the cause of their difficulties with the Abenakis, and was accused of instigating attacks on the settlements. This is inferred by pro-English historians from a letter to Rale from Vaudreuil, governor at Quebec, expressing satisfaction at Rale's success in uniting the savages against the English, and agreeing to furnish military assistance, should it be required. This communication, dated 25 Sept. 1721, was among papers obtained by the expedition sent out from Boston under Colonel Westbrook to seize Rale in 1721, and is now preserved in the archives of Massachusetts. Among these papers, also, was Rale's dictionary of Abenaki, now in the Harvard library and printed in 1833, in the memoirs of the American Academy of Arts and Sciences, See DUMMER'S WAR.

Raleigh, *SIR Walter*, English military and naval commander, and author: b. Hayes Barton, a farmstead in the parish of East Budleigh, Devonshire, about 1552; beheaded, London, 29 Oct. 1618. He was the son of Walter Raleigh by his third wife, Katharine, daughter of Sir Philip Champenowne of Modbury, and widow of Otho Gilbert of Compton. Raleigh was educated at Oriel College, Oxford; served with the Huguenot army in France in 1569; remained there for five years or more; and, with his half-brother, Sir Humphrey Gilbert, engaged in voyages of "discovery"—and piracy—against the Spaniards in the West Indies. In 1579, he established himself at court in the friendship of men of influence—Leicester, Oxford, Sidney, Walsingham; he served with distinction in Ireland (1580-81); and then, returning to court in December of the latter year, he won, and for some years retained, the high favor of Elizabeth. Through her successive grants of monopolies and estates, he became one of the wealthiest of her courtiers. In 1584 he was knighted; in 1585 he was appointed warden of the stannaries (*i. e.* of the mines of Devon and Cornwall), lord lieutenant of the latter county, and vice-admiral of both; and in 1585-6 he was M.P. for Devon. He was also captain of the queen's guard.

From this period while Raleigh was the

favorite of Elizabeth dates his chief connection with the exploration and settlement of North America. In 1584, '85, '86, '87, and '89, he sent expeditions to Virginia; but as the Queen forbade his personal participation, his efforts to colonize were unsuccessful. Raleigh's services against the Spanish Armada, 1588, were not conspicuous. He assisted in organizing the land forces; but there is no proof that he took any part in the sea-fighting. In 1591 and 1592, he was prominent in the preparation of squadrons for service against Spain; but was recalled from the later expedition because of the Queen's anger at Raleigh's intrigue with one of her maids of honor, Elizabeth Throgmorton. He was soon set at liberty, and his marriage to Elizabeth Throgmorton followed. Not until 1597, however, did Raleigh regain the Queen's favor.

Meanwhile he was free to explore America in person. His objective point was Manoa, a city supposedly situated in South America and possessed of untold wealth. In 1595, with a fleet of five vessels, he captured the town of San Josef, Trinidad, and explored the Orinoco for 400 miles. He did not find Manoa; but his brilliant service in the English attack upon Cadiz (June 1596), and as commander at the taking of Fayal (1597), completed his restoration to favor. In 1597 he was made M.P. for Dorset; in 1601, for Cornwall. In 1600 he was appointed governor of Jersey.

The death of Elizabeth, however, occasioned a change in Raleigh's fortunes. Raleigh's enemies had made James believe that Raleigh was opposed to his accession. James immediately deprived him of all offices, and on 17 July 1603, committed him to the tower. On November 17, he was tried for treason. According to modern rules the evidence was insufficient; but Raleigh was declared guilty and was sentenced to be executed on 11 December.

On 10 December, however, he was reprieved and committed to the tower. Here for 13 years he lived in tolerable comfort with his wife, son, and personal servants. He devoted himself to study and to scientific experiments, and, at the request of Prince Henry, began his chief literary work, the '*History of the World*.' At length, in March 1616, on his promise to guide an expedition to a gold mine in America, Raleigh was released. The Spanish ambassador, fearing an invasion of Spanish possessions or an attack on the Mexican plate-fleet, protested. The king, however, warning Raleigh that either act would be punishable by death, allowed him to proceed. Raleigh ignored the warning, captured San Tomás, and, failing to reach the mine, was kept from attacking the plate-fleet only by the refusal of his followers. On Raleigh's return to England, Gondomar, the Spanish ambassador, demanded his immediate execution. Raleigh's admissions and perjuries left the king's commissioners no choice. On 28 October, the Justices of the King's Bench ordered Raleigh's execution under the suspended sentence of 1603. He was executed in the Old Palace Yard, 29 Oct. 1618.

Of Raleigh's poetry, so highly praised by his

contemporaries, but little was published during his life, and much is probably lost. Many poems once attributed to him are now attributed to others. The poems certainly his have been collected by Dr. Hannah, 1885. Of Raleigh's prose works, the most important is his 'History of the World' (1614).

Bibliography.—The chief lives of Raleigh are those of William Oldys (1736); Thomas Birch (1751); Arthur Cayley (1805); Patrick Fraser-Tyler (1833); Edward Edwards (1868); J. A. St. John (1868); and Mr. William Stebbing (1891). That by Mr. Stebbing is the best. There is also a popular sketch by Mr. Edmund Gosse (1886). Consult also Mr. S. R. Gardiner's 'History of England,' and the publications of the Hist. MSS. Comm., and, concerning Raleigh's literary work, the introduction to Dr. Hannah's edition of his 'Poems' (1885), the bibliographies of Dr. Brushfield, and his 'Sir Walter Raleigh and His History of the World' (1887).

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Raleigh, Walter, English author and educator. He was educated at University College, London, and King's College, Cambridge, and was for many years professor of modern literature at University College, Liverpool. Since 1900 he has occupied the chair of English language and literature at Glasgow University. He has published: 'The English Novel' (1894); 'Robert Louis Stevenson' (1895); 'Style' (1897); 'Milton' (1900); 'Wordsworth' (1903); etc.

Raleigh, N. C., city, capital of the State, county-seat of Wake County; in lat. 35° 47' N., lon. 78° 48' W.; on the Southern and the Seaboard Air Line R.R.'s; about 28 miles southeast of Durham, 148 miles northwest of Wilmington, and 60 miles northeast of Pinehurst.

Topography.—Raleigh occupies an elevation of over 300 feet. It is just northeast of the geographical centre of the State, in the upper valley of the Neuse River, which flows southeast to Pamlico Sound. The city, platted around a beautiful park of 10 acres, which is called Union Square, is divided into four sections by four broad streets which extend from this centre. The magnificent oak trees in Union Square give Raleigh the popular name of "The City of Oaks."

Manufacturing.—In 1900 the manufacturing interests of Raleigh represented an invested capital of \$1,611,000, with products valued at \$2,204,000. Cotton and tobacco products are the leading articles of commerce. The largest manufacturing establishments are flour mills, phosphate works, foundries, machine shops, car shops, wood-working factories, ice factories, cotton mills, and cottonseed-oil mills. Other manufactures are underclothing, hosiery, cigars, carriages, and agricultural implements.

Buildings and Cemeteries.—The State Capitol, a substantial granite structure, stands in Union Square; nearby are the Supreme Court building, the State Library, State Geological Museum, Raney Library, Governor's mansion, U. S. Government post-office and court-house. Other prominent public buildings are the county court-house, State insane asylum, State peniten-

tiary, State institutions for the blind, one for white and one for colored, State Institute for the Deaf and Dumb, Old Ladies' Home, and Rex Hospital. There are here National and Confederate cemeteries. The National Cemetery contains 1,207 graves, 572 of which are unknown dead.

Education.—The educational institutions are the Peace Institute (Presbyterian), Saint Mary's (P. E.), and the Baptist Female University, for young women; Raleigh Male Academy, for boys. The State College of Agricultural and Mechanic Arts, opened in 1889, has 15 buildings, and accommodations for 600 students. Other schools are King's Business College; the Shaw University (Baptist) and Saint Augustine's School (P. E.) are for boys and girls. Several State educational institutions have been mentioned. There are graded and normal schools for white and colored pupils. A large summer school for white teachers is held here each year. Not far distant from the city are the State University and the Wake Forest College (Baptist). The Supreme Court Library contains 14,000 volumes, the State Library 35,000 volumes, and the Olivia Raney public library 8,000 volumes. All the religious denominations have handsome churches for both races. There are two orphanages, one under the auspices of the Methodist Church, the other in charge of the Roman Catholic Church. There are three daily and ten weekly newspapers.

Banks and Finances.—There are two national banks, one state bank, two savings banks, and one trust company. The five banks and the trust company have a combined capital of \$555,000 and deposits amounting to \$2,541,610. The assessed property valuation, in 1903, was \$6,000,000. There are excellent fire and police departments, and all municipal improvements are provided for by a regular tax.

Government.—The city is governed under a charter of 1899 which provides for a mayor and common council elected every two years. The administrative officials are chosen by the mayor and council, except the tax collector and city clerk who are elected by the people.

History.—The site of the present city was selected in 1792 by the legislature, for the location of the State capital. In the same year the city was founded and named in honor of Walter Raleigh (q.v.). In 1794 the legislature held its first session in Raleigh. The city was incorporated in 1795, and in 1803 was re-incorporated. The city was occupied by General Sherman part of 1865. Pop. (1880) 9,205; (1890) 12,678; (1900) 13,643; (1910) 19,218. Consult Battle, 'The Early History of Raleigh.'

GEORGE ALLEN,

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Râles, sounds heard in the respiratory passages, due to certain modifications in the normal structure of the bronchi or alveoli, or both. Sounds that originate in the pleural cavity are distinguished as friction sounds. Râles are new sounds, not common to healthy lungs, and are created either in the bronchi, bronchioles, air-vesicles, or pathological cavities. They are due to a number of causes, the most frequent of which are (1) the passage of air through narrowed bronchi, such narrowing being the result of inflammation of the mucous membrane or of muscular spasm, and (2) the passage of air



SIR WALTER RALEIGH.

through or by a certain amount of fluid, either mucus, pus, blood-serum, or combinations of these. Râles of the first type are dry; those of the second are called wet. The dry râles are usually musical, and on placing the ear to the chest, where they are present, one hears either high-pitched whistling sounds, sibilant râles, or low-pitched, blowing, or sonorous râles, depending on the source of the sound, whether the finer or larger bronchi. Both types may commingle. Such râles are common in asthma, in the chronic bronchitis of emphysema, and in the early stages of a bronchitis, before the exudation of mucus has begun. The moist râles are usually of two kinds: (1) very fine, or subcrepitant râles, resembling in sound the rubbing of a lock of hair between the fingers, and (2) larger mucous râles. The former are common in various types of disease in which the air-vesicles are involved, broncho-pneumonia, lobar pneumonia, tuberculous pneumonia, etc. They are due to congestion and the pouring out of blood-serum into the area. The moist mucous râles are present in bronchitis. They occur in the larger bronchi, or in cavities, and resemble the bubbling and gurgling sounds of water in a pipe. It requires the trained ear of the physician to distinguish between the different varieties, and much experience to be able to prejudge the significance of the râles after they are heard.

Ralph, James, American author: b. Philadelphia, Pa., about 1698; d. Chiswick, Surrey, England, 24 Jan. 1762. He was a clerk to a Philadelphia conveyancer, and in 1724 went to England with Benjamin Franklin, who praises him as "ingenious" and "extremely eloquent." As an actor, editor, and newspaper writer he was not successful. He then became a teacher in Berkshire, and was welcomed as an adherent of the Prince of Wales' party, which he supported by pamphlet, poem, and newspaper contribution. Afterwards bought into silence, he received a pension on the accession of George III. Pope ridicules "a thing of his, entitled 'Night,' a poem," in the lines of the 'Dunciad,'

"Silence ye wolves! while Ralph to Cynthia howls,
And makes night hideous—Answer him, ye Owls!"

Franklin pathetically complains that he "did his best to dissuade Ralph from attempting to become a poet"; but apparently Pope was more effective. Ralph's 'History of England during the Reigns of King William, Queen Anne, and George I.' (1744) is valuable for the information it contains.

Ralph, Julian, American author: b. New York 27 May 1853; d. there 20 Jan. 1903. At 13 he began newspaper work as typesetter and later engaged as reporter at Red Bank, N. J. From here he removed to Webster, Mass., to edit *The Times* of that place, and thence to New York, where he came into prominence in reporting the Beecher trial in 1875. He at once engaged with the *New York Sun* and held a position on its staff for 20 years. He was in the East during the Chinese-Japanese war in 1894 reporting that struggle and traveling in many parts of Asia. Returning to London he joined the foreign staff of the *New York Journal* and reported the Turkish-Greek war, Queen Victoria's Diamond Jubilee in 1897, and the crowning of the Czar of Russia. The outbreak of the Boer war found him again a field correspondent,

attached to the commands of Lords Roberts and Methuen. He returned to America in 1902 and continued his work of special correspondent up to the time of his death. He had a wide knowledge of affairs and a picturesque and vivid style. Some of his books are: 'On Canada's Frontier'; 'Our Great West'; 'Chicago and the World's Fair'; 'People We Pass'; 'Alone in China'; 'An Angel in the Web'; 'At Pretoria'; 'War's Brighter Side.'

Ralph Iron. See SCHREINER, OLIVE.

Ralph Roister Doister, a play by Nicholas Udall. It was the first English comedy, although not printed until 1556, and probably written about 1540. At this time its author was head-master of Eton, and the comedy was written for the schoolboys, whose custom it was to act a Latin play at the Christmas season. An English play was an innovation, but 'Ralph Roister Doister' was very successful. It follows Terence and Plautus, Ralph, "a swaggering simpleton, a feeble, conceited fop of the days of Henry VIII.," having his prototype in the 'Miles Gloriosus.' It is in riming couplets, interspersed with songs. In very recent years it has been produced at Tufts College, Medford, Mass.

Ralston, râ'stôn, William Ralston Shedden, English Russian scholar: b. London 4 April 1828; d. there 6 Aug. 1889. He was the son of W. P. Ralston Shedden and educated at Cambridge. During the period of his college years his father entered upon a litigation to obtain possession of some Ayrshire property and in this effort dissipated his whole fortune. The name of Shedden becoming somewhat notorious in connection with the suit, the son adopted the additional surname of Ralston; and obtained a post at the British Museum in 1853. He gave his attention to the study of Russian, a language then little known. He published 'Kriloff and His Fables' (1868), a translation of Turguénieff's 'Liza' (1869); 'Songs of the Russian People' (1872), and 'Russian Folk Tales' (1873). He made several journeys to Russia and became the life-long friend of Turguénieff, and was also made a corresponding member of the Imperial Academy of Sciences of Saint Petersburg. He projected an exhaustive history of Russia, but did not publish it. In 1874, however, he published his Oxford Tylorian lectures, 'Early Russian History.'

Ram, Thomas, English bishop: b. Windsor 1564; d. Dublin 24 Nov. 1634. He was educated at Eton and Cambridge, and in 1599 accompanied Essex to Ireland, and in the following year was made dean of Cork. On 2 May 1605 he was consecrated bishop of the united sees of Ferns and Leighlin. Ram was a careful bishop, constantly resident, and did what he could to maintain schools, but the recusant clergy excommunicated all who used them. He was one of the twelve bishops who, 26 Nov. 1626, signed a protest against tolerating popery.

Ram, Battering. See BATTERING-RAM.

Ram, Hydraulic. See HYDRAULICS.

Râma, ră'ma, in Hindu mythology, the name common to a personage appearing as three incarnations of Vishnu (q.v.), all great warriors of surpassing beauty. These three forms are distinguished as Bala Râma or Balaram, Para-

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surama or *Parasram*, and *Rāmā Chandra* or *Dasrat Rāmā*. *Rāmā* first appeared in the sixth incarnation, and his deeds are celebrated in a poem called the '*Rāmāyana*,' the best great epic poem of ancient India. In this poem all three of the heroes are celebrated, but the last-named, or *Rāmā Chandra*, has his life and deeds detailed at greater length than the others. The story tells how *Sita*, his wife, was carried away to Ceylon by the king of demons, one *Ravana*, and how *Rāmā* rescued his wife, bridging the water between Ceylon and India by the aid of an army of monkeys. He slew the demons and became a great hero. The *Rāmāyana* is often likened to the '*Iliad*,' to which it bears great resemblance.

Ramadan, *rā-mā-dān'* or *rām-a-dān'*, the ninth month in the Mohammedan calendar, has 30 days. Since the Mohammedan year is a lunar one, Ramadan comes at all the seasons, being eleven days earlier each year. In about 33 years the month has made a complete cycle of the year. Ramadan is important chiefly because it is supposed to be the month in which Mohammed received his divine revelation and is therefore made a month of solemn observance among the faithful. During the 30 days the true believer abstains, between dawn and sunset, from all eating, drinking, smoking; bathing and all other delights of the body are likewise forbidden. The more devout of the Mohammedans remain behind closed blinds during the day and devote themselves to prayer and to reading the Koran, and particularly *Sura*, in the second book of which are found the references to the fast of Ramadan. There are special prayers, 20 in number, which during this month are added to the usual evening prayers, repeated at dusk by the true believer. Ramadan is also the month in which the Turkish Government usually takes occasion to institute reforms, or to promise to institute them, apparently to curtail the national expenses and lighten the tax burden, and generally to undertake those measures that tend to popularize the government with its subjects.

The rigid fast enjoined by the Koran is not required of those who are unable, because of physical reasons, to withstand it. Thus mothers with young babies, and those expecting to become such, infirm old people, people weakened by illness, and others in like circumstances, are excused in whole or in part. In some instances, as is the case with soldiers on active duty, the remission is conditional upon a future fast of similar length and severity.

The fast of Ramadan terminates each day with nightfall, and as the Mohammedan keeps the letter rather than the spirit of the law of the Koran, the nights of this month are filled with feasting, the more joyous because of the abstinence during the day. These repasts often become wild revels, or even flagrant debauches, which last until daylight, when the gluttonous participants once more partake themselves to fasting and prayer. Following the fast of Ramadan for three days there is celebrated the feast of the *Lesser Beiram*, during which all labor ceases and the Mohammedans give themselves to all sorts of table enjoyments.

Rāmāyana, *rā-mā'ya-na*. See SANSKRIT LANGUAGE AND LITERATURE.

Rambaud, *rān-bō*, **Alfred Nicholas**, French historian and litterateur: b. Besançon 2 July 1842. He was educated at the *Ecole Normale*;

in 1871 became professor of history at Caen and in 1875 was transferred to the same post at Nancy. In 1879 he became secretary to the Ministry of Public Instruction, and in 1881 was nominated to a position in the Normal School at Caen and shortly afterward made professor of modern history at Paris. From 1896 to 1898 he was minister of public instruction in the Méline Cabinet. His chief works are '*La Russie Epique*' (1876); '*Histoire de la Russie*' (1878); '*Histoire de la Civilisation Française*' (1887); '*Histoire de la Civilisation Contemporaine en France*' (1888); in collaboration with M. Lavissee, '*Histoire Generale de la France du IVe Siècle à nos Jours*' (1892).

Ramberg, *rām'bërg*, **Arthur**, **BARON**, German painter: b. Vienna 4 Sept. 1819; d. Munich 5 Feb. 1875. He studied art at Hanover and early made a tour in Italy, Hungary, and Styria. In 1840 he attended the university at Prague, while at the same time uniting the pursuit of art with his other studies. In 1842 he became a pupil at the Art Academy of Dresden under J. Hübner, and among other early pictures produced his '*Wedding of Dwarfs*' after Goethe; and '*The Emperor Henry I. on His Hungarian Campaign*.' In 1850 he went to Munich and executed a series of genres illustrating the works of Schiller. In 1860 he was appointed professor to the Art School in Weimar, and six years later took a similar position in the academy of Munich. His subsequent productions include '*The Court of Frederick II. in Palermo*'; and, among his genres, most notable are his '*Hermann und Dorothea*' after Goethe; and '*Luise*,' after the poem of J. H. Voss, which latter was much admired for its brilliancy in design and execution. He also frescoed the walls of Luther's chamber at Wartburg; and for the Grand Duchess of Saxe-Weimar illustrated the tale of the '*King of the Frogs*.'

Ramberg, *rām'bërg*, **Johann Heinrich**, German artist: b. Hanover 1763; d. there 6 July 1840. He first showed his talent by drawings of scenes in the Harz Mountains. These became known to George III., king of England, his sovereign, as Elector of Hanover, who induced him to go to London, where he provided for him. He remained there nine years, and perfected himself under Reynolds, Murphy, Bartolozzi, and other engravers of the first rank in England, engraved drawings of his. In 1788 the king sent him to Italy, whence he returned to Hanover, where he was appointed painter to the court. Few painters and designers have produced so many works as he; but this rapidity prevented the full development of his talent. He distinguished himself particularly in humorous drawings; as in his illustrations to '*Reineke Fuchs*' and '*Eulenspiegel*.' The drawings in the magnificent edition of Wieland's works are all by him; some he etched himself.

Rambler, **The**, a semi-weekly periodical after the model of Addison's '*Spectator*,' published in London by Dr. Samuel Johnson 1750-52, and, like its prototype, of much influence upon English life in the 18th century.

Ramboo'tan, the fruit of the tree *Nephelium lappaceum*, of the order *Sapindaceae*, much prized in the Malayan Archipelago. It is about the size of a pigeon's egg, of a red color, rich and of a pleasant acid taste. The fruits litchi

and longan (see *LITCHI*) are obtained from other trees of this genus.

Rambouillet, rân-boo-yâ, Catherine (DE VIVONNE), MARQUISE DE, French social leader: b. Rome 1588; d. Paris 2 Dec. 1665. She is worthy of remark as the founder of the Hôtel de Rambouillet, whose hospitality was extended to the learning and wit of Paris, and which became a literary and political centre. This salon was developed in opposition to the French court circle, whose vulgar and barbarous manners and speech it strove to offset by elegance and refinement in both, and it soon became the rendezvous of celebrity and wit. Among the critics, poets, and scholars who resorted thither were Malherbe, Corneille, Chapelain, Scarron, Saint-Evremond, La Rochefoucauld, Mme. de Sévigné. Henry IV. and Louis XIII. were quite indifferent to letters, and in default of royal patronage the Hôtel assumed the role of arbiter in matters literary. Imitators perverted the original characteristics of the group into pedantry and affectation and occasioned the historic satires of the great Molière in 'Les Précieuses Ridicules' and 'Les Femmes Savantes.' The Hôtel did much to add to the precision and finish of the language and the establishment of good taste; and it was unfortunate that through the playwright its name took on the nature of a derisive epithet. Consult: Röderer, 'Mémoire pour servir à l'Histoire de la Société Polie en France pendant le Dix-septième Siècle' (1834); Brunetière, 'Nouvelles Etudes Critiques' (2d ed. 1886); Vincent, 'The Hôtel de Rambouillet' (1900).

Rambouillet, a breed of sheep (q.v.).

Rameau, Jean Phillippe, zhôn fê-lêp rā-mô, French musical composer and theorist: b. Dijon 25 Sept. 1683; d. Paris 12 Sept. 1764. Having early acquired some skill in music he joined a company of performers, by whom when he was 18 a composition of his was represented at Avignon. He studied sacred music under Marchand at Paris; was appointed organist in Clermont cathedral, and in 1722 made his reputation as a musical theorist by publishing 'Traité de l'Harmonie.' Four years after appeared his 'Nouveau Système de Musique Théorique,' which was followed by his 'Génération Harmonique.' His greatest claim to musical reputation is based upon his dramatic compositions, of which 'Hippolyte et Aricie' appeared in 1732 and was followed by 22 works of grand opera, of which the most notable is 'Castor and Pollux' (1737). In 1750 he published his 'Dissertation sur le Principe de l'Harmonie,' in which he reduces harmony to one single principle—the fundamental bass, on which he proves all the rest to depend. This work procured him an invitation from the court to superintend the opera at Paris. Louis XV. granted him a patent of nobility, and the order of Saint Michael, and in 1764 a statue was raised to him in his native city. Consult: Pougin, 'Rameau, Essai sur sa Vie et ses Œuvres' (1876).

Ramée, rā-mā', Louise de la. See OUIDA.

Ramée, Pierre, pē-âr rā-mā (Latinized, PETRUS RAMUS), French humanist and mathematician: b. Cuth, near Soissons, 1515; d. Paris 26 Aug. 1572. He went to Paris about 1523 when he was but eight years old, and became lackey to a rich student in the College of

Navarre, but devoted to self-improvement all the time he could spare. After attending a course of philosophy he was admitted to the degree of M. A., on which occasion he questioned the infallibility of Aristotle. His 'Institutionum Dialecticarum Libri III' (1543), and 'Animadversionum in Dialecticam Aristotelis Libri XX' raised a storm against him in the university; their publication was prohibited, and extant copies ordered to be burned before the Royal College of Cambrai. Having obtained the patronage of the Cardinal de Lorraine, the prohibition of lecturing imposed in 1543 was withdrawn in 1547, and in 1551 he was appointed professor of rhetoric and philosophy in the College Royal at Paris. His spirit of free inquiry ultimately led him to become a Protestant, and he was obliged to flee from Paris, but he unfortunately returned in 1571 and was killed in the massacre of Saint Bartholomew's. His works, relating to grammar, logic, mathematics, etc., are numerous.

His doctrines were widely diffused. France, England, and particularly Scotland, were full of Ramists. His logic was introduced into the University of Glasgow and in the German universities. Consult: Waddington, 'Ramus, sa Vie, see Ecrits et ses Opinions' (1855); Desmazes, 'Ramus' (1864); Lobstein, 'P. Remus als Theolog' (1878); Voigt, 'Ueber den Ramismus der Universität Leipzig' (1888); Owen, 'Skeptics of the French Revolution' (1893).

Ramenghi, rā mēng'gē, Bartolomeo. See BAGNACAVALLLO.

Rameses, rām'ē-sēz, or Ramses (in Egyptian "the Child of the Sun"), the name of several Egyptian kings, especially of the 19th and 20th dynasties, of which the most notable are:

Rameses II. (Gr. Sesostris), son of Sethos. He was the third king of the 19th dynasty, and reigned 1300-1280 B.C. He made a campaign against Syria and advanced victoriously as far as Berytus (Beirut), on the Phœnician coast of the Mediterranean. He next extended Egyptian dominion over Ethiopia, and a part of Arabia and began the cutting of a canal between the Mediterranean and Red seas. But the great event of his reign was his war with the Khita, supposed to be the Hittites. He defeated a confederation, among whom the Khita were the chief, in a great battle near the Kadeshon (Orontes) in Syria, and subsequently took Jerusalem and other places. He fortified the east of Egypt by erecting a great wall from Pelusium to Heliopolis and Tanis. In his reign Thebes rose to great magnificence. Here he erected the splendid temple known as the Rameseum, with a sitting statue of himself more than 60 feet high. He is the king who oppressed the Hebrews, and the father of Menephthah, under whom the exodus took place. He had 111 sons and 59 daughters, and we have more records and statues of him than of any other Pharaoh. His mummy was discovered near Thebes in 1881 and in 1886 placed in the Egyptian Museum at Cairo.

Rameses III., the Rhampsinitus of Herodotus, belonged to the 20th dynasty, and was also a king of note, some of whose achievements seem to have been ascribed to Sesostris. He reigned 1180-1150 B.C., during which period he had to withstand many invasions of the surrounding nations, but was uniformly successful

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in war, and active in great undertakings in time of peace. At Medinet-Abu he built a magnificent temple in memory of his warlike achievements in Nubia and Syria. The mummy of Rameses III. was found in 1886. Nine other kings of the name of Rameses are mentioned as having belonged to the 20th dynasty (1150-1050).

Rameses, a city of Egypt, in the district of the same name, supposed to be the same as Raamses, one of the treasure-cities built for Pharaoh by the children of Israel during their bondage in Egypt. It was from this point that the Israelites set out in their exodus from Egypt; and its geographical position is therefore of great interest as determining their route toward the Red Sea. The district or "land" of Rameses has been identified by some with Goshen, or a part of Goshen. As for the city, some have supposed it to be in the neighborhood of On or Heliopolis; others somewhere near Old Cairo, on the opposite side of the Nile from ancient Memphis; Dr. Robinson placed it in the valley of Wady Toumilât, toward the east end of that valley, in the line of the fresh-water canal to Ismailia; and Dr. Lepsius thought he had found its site at Tell-el-Maskhuta, in that region. This site, however, has been identified by Naville with Pithom. It is argued in favor of the conjecture which places it in the neighborhood of Memphis, that Rameses must have been near the capital or residence of Pharaoh at the time of the exodus, and as this was Memphis, Rameses must therefore have been near this city. But though Memphis was the ancient capital, it does not follow that the Egyptian king invariably resided there. Tanis or Zoan was also a royal residence, and Brugsch identifies Rameses with it, an identification which suits the biblical narrative quite well. Upon the name of the city is based the theory which identifies Rameses II. with the Pharaoh of the oppression.

Ramesseum, rām-ēs-sē'ūm, a temple of ancient Egypt, on the western bank of the Nile, situated opposite Thebes, and near the modern village of El-Kurneh. Its ruins constitute one of the most interesting group of ancient Egyptian remains, owing to the rich mural sculptures of great historical value which are there preserved. The principal features of the temple were two great courts about 140 feet long by 180 feet wide, entered through a propylon 225 feet wide. The front court contains the fragments of a gigantic statue of Rameses II. carved from a single block of granite and estimated to have weighed, when entire, more than 850 tons. The statue was 60 feet high and the monarch was represented as seated on his throne. The columns in both courts are among the most beautiful specimens of Egyptian architecture. On the wall of the second court is a great series of sculptures depicting a battle between Rameses II. and the Hittites, in which the king is shown as victoriously pursuing the enemy's forces. Opening on the second court is a beautiful hall of pillars, the walls of which are adorned with battle scenes and religious subjects. A smaller chamber adjacent to the hall of pillars is notable for its astronomical ceiling. The temple was described by Diodorus Siculus under the name of the Tomb of Osymandyas. It is sometimes called the Memnonium.

Rameswaram, rā-mēs'wa-rām, a low sandy island between the southern extremity of

India and Ceylon, and between the Gulf of Manaar and Palk Strait, about 14 miles long and 5 wide. It is one of the islands that form the chain known as Adam's Bridge, and contains a famous Hindu temple of Dravidian architecture, which attracts many pilgrims from all parts of India. The port of the island is Pambam; it also contains a small town called Rameswaram. There is a passage for ships of moderate size between this island and the continent. Pop. 17,854.

Ram'ie, Rhea, or China Grass, *Bahmeria tenacissima* and *B. nivea*. Shrubs, five to eight feet high, producing in the bark of their stalks or stems a bast fibre. Technically ramie and rhea are derived from *tenacissima* and China grass from *nivea*. This distinction has never been regarded, however, in the economic literature of the subject, the term ramie being commonly used to designate all *bahmeria* fibre, China grass being either a synonym or the trade name of the Chinese fibre as imported. In the statements which follow, therefore, ramie and China grass may be considered as synonymous terms, referring to the fibres of both species, as they are practically identical from the standpoint of commercial utility, and as regards culture, preparation and manufacture.

The fibre is strong and durable, is least affected by moisture of all fibres, and takes first rank as a textile substance. It is adapted to the widest range of uses of any known textile. It has been made into stuff goods for men's wear, ladies' dress goods, upholstery, curtains, laces, and embroideries. The pile of velvets and plushes, stockings, underclothing and knit goods, table damask, napkins, handkerchiefs, shirtings, sheetings, sail duck, carpets, cordage, fishing nets, and yarns and thread of all descriptions, and it makes a superior bank-note paper. It is also used to adulterate silk, and for imitation silk goods. The plant has been the subject of experiment in nearly every country in the world, and probably millions of dollars have been spent or wasted, in attempts to exploit the industry, or in the construction of machines to extract the fibre. Yet the fact remains that the commercial fibre is only produced in China and by rudest hand methods, Japan coming the nearest to establishing a commercial industry for the production of export fibre. Ramie is neither grown nor to any extent manufactured in the United States, though its culture was experimented with for years, and inventors and textile manufacturers have struggled with the machine problem, and with the after preparation and the spinning of the fibre. As far as this country is concerned, the fact that the Chinese fibre can be laid down in San Francisco for about 4 cents a pound condenses the entire ramie situation into a nutshell. Cultivation in this country would not pay at such prices, and there is not a machine in existence that could produce enough marketable fibre in a day to pay for the cost of running the machines when American wages are considered.

Ramie manufactures have been on the market for years, derived from European sources, and made from raw fibre produced in China. And many manufactures made in whole, or part, from ramie are sold as something else, because the fibre is unknown to the public, or because it is used as an adulterant, as in silk fabrics. See CHINA, CORDAGE, CORDAGE INDUSTRIES, FIBRE HEMP, ROPE.

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Consult 'Report on Rhea Fibers' (Watson, 1875); Bulletin Royal Kew Gardens; Dictionary Economic Products of India; Reports (1, 2, and 7) Office of Fibre Investigations, Department of Agriculture; also the French publications of Favier, De Landtsheer, Michatte, Roux, Ringlemann, and the *ramiè* literature published by the Ministry of Agriculture of France.

CHAS. RICHARDS DODGE.

Ramillies, *rā-mē-yē*, a village of Belgium, in the province of Brabant, 13 miles north of Namur and 28 miles southeast of Brussels. On 23 May 1706 the Duke of Marlborough gained here a signal victory over the French under Marshal Villeroi and the Elector of Bavaria. The numbers were about 60,000 on each side; the loss of the allies was about 4,000 men, that of the French 15,000. The consequence of this battle was the immediate evacuation by the French of the chief strongholds in the Netherlands. See SPANISH SUCCESSION, WAR OF THE.

Ramirez, *rā-mē-rēth*, **Ignacio**, Mexican poet and philosopher: b. San Miguel el Grande 23 June 1818; d. Mexico 15 June 1879. He was descended from a family of pure Aztec blood, received a good education and early devoted his attention to literature. He founded 'Don Simplicio' in 1846 and was author under the pseudonym 'The Necromancer' of many philosophical articles and satirical poems. His writings have never been collected, but his 'Manual of Rudimentary Knowledge' was published in 1884.

Ramman, *rām'man*, or **Rimmon**, a deity worshipped by the Babylonians and sometimes called also Hadad. He was the god of the all-pervading atmosphere, especially of the winds. In this respect he may be likened to the Meeruts, or storm gods of northern India, for his name is derived from a Babylonian word meaning "loud sounding" or "bellowing." In the Bible "the House of Rimmon" is spoken of as his temple at Damascus (2 Kings v. 18). He is symbolized by the bull; is the god of storms and floods and of the charge of battle and is represented armed with thunderbolt and battle-axe. Consult: Baethgen, 'Beiträge zur semitischen Religionsgeschichte' (1902); Jastrow, 'Religion of Babylonia and Assyria' (1898).

Rammohun Roy, *rām-mō-hūn' roi*, Hindu religious reformer: b. Burdwan district, province of Bengal, India, 1772; d. Stapleton Park, near Bristol, England, 27 Sept. 1833. He was a Brahman of strict education, but early renounced the polytheism of Brahminic theology. For five years he was dewan, or principal native officer in the collection of the revenues, in one of the districts of East India company's services. He afterward studied Latin, Greek, and Hebrew. A careful study of the sacred writings of the Hindus had convinced him that the prevailing religious notions of the Hindus were grounded upon a gross perversion of their religion, the original records of which appeared to him to inculcate a system of pure theism. He now became anxious to reform the creed and practice of his countrymen, and determined to devote his talents and his fortune to this undertaking. A work of his in Persian on 'The Idolatry of all Religions' aroused much protest. In 1814 he went to live in Calcutta, where as early as 1818 he had united a number of intelligent Hindus

in a species of monotheistic worship. He translated the Vedānta, a compendium of the doctrines contained in the Vedas or ancient sacred books of the Hindus, from the Sanskrit into the Bengali and Hindustani languages, and distributed the translation gratuitously. This he afterward published in English, for the purpose of proving to his European friends "that the superstitious practices which deform the Hindu religion have nothing to do with the pure spirit of its dictates." From the perusal of the New Testament he found (he says) the doctrines of Christ more conducive to moral principles, and better adapted for the use of rational beings, than any other which had come to his knowledge. In 1820 he accordingly published the 'Precepts of Jesus the Guide to Peace and Happiness,' consisting chiefly of a selection of moral precepts from the Evangelists, and Unitarian in its character. On 23 Jan. 1830 he founded at Calcutta the Brahmiya Somaj, from which was derived the Brahmo Somaj (q.v.).

Rammohun Roy, in his doctrinal views, was a Unitarian, holding, however, the pre-existence and superangelic dignity of Christ, and considering the doctrine of the Trinity as a species of polytheism. He believed possible a combination of Brahminism and Christianity. His views were at first much misunderstood in England, and it appears that even Bishop Heber regarded him as an atheist. In 1830 he went to England in the character of ambassador from the king of Delhi (who gave him the title of Rajah). Consult: Carpenter, 'A Review of the Labors, Opinions, and Character of Rajah Rammohun Roy' (1833); Fox, 'Discourse on Occasion of the death of Rajah Rammohun Roy' (1833); Max Müller, 'Biographical Essays' (1883).

Ramo'na, a novel by Mrs. Helen Hunt Jackson, published in 1884. It is a picturesque, sympathetic, and faithful picture of Spanish and Indian life in California. Though the story is a passionate appeal for justice to the Indian it is in form one of the most delicate and beautiful examples of romantic literary art that English affords.

Ram'pion, a biennial herb (*Campanula rapunculus*) of the order *Campanulaceæ*. It grows about 30 inches tall, has a parsnip-like root, obovate leaves, lilac flowers in a spike or raceme, and very small seeds. It is a native of Asia, Europe and northern Africa, where it is cultivated for its roots and leaves, the former of which are used like radishes, the latter like spinach. The plants do best in light, rich loam, partially shaded and well supplied with moisture but not wet. Since early spring sown plants are likely to run to seed, other sowings should be made in early summer. The plant is less popular in America than abroad.

Rampolla, *rām-pōl'lā*, **Mariano**, MARQUIS DEL TINDARO, Roman prelate: b. at Polizzi, Sicily, 17 Aug. 1843. Born of an aristocratic family he was educated at Rome and took priest's orders at 23. Several years later he entered diplomacy and was made secretary to the Papal nunciature at Madrid. During the absence of the Nuncio Simonei in 1876 he acted so brilliant a part during the Carlist war as to secure his appointment as secretary of the Congregation of the Propaganda. In 1885, being then Papal Nuncio

at Madrid, he proposed Pope Leo XIII. as arbitrator in the dispute between Spain and Germany regarding the Caroline Islands. In 1887 he was created cardinal and made papal secretary of state which post he held until the appointment of the new Pope Pius X. in 1903. The foreign policy of the Vatican was influenced by him and consisted of a conciliatory attitude toward France together with an opposition to the Triple Alliance, with the ultimate end in view of re-establishing the temporal power of the pope. Upon the death of Leo XIII. Cardinal Rampolla was one of the most prominent candidates to the succession.

Rāmpur, rām-poor', India, (1) capital of a state of the same name, on the left bank of the Kosila River, 18 miles east of Moradabad. It is the residence of the nawab, who represents the Rohilla chieftain of Rohilkhand. A lofty mosque is a specimen of oriental magnificence. The place is famous for its shawls, damask, sword-blades and jewelry. Pop. (1901) 77,862. (2) The state under the superintendence of the government of the United Provinces has an area of 899 square miles.

Ramsay, rām'zī, Allan, Scottish poet: b. Leadhills, Lanarkshire, 15 Oct. 1686; d. Edinburgh 7 Jan. 1758. The death of his father in early life forced him to seek a means of livelihood in the Scottish capital. There he became bound as an apprentice to a wig-maker, which occupation he continued after his apprenticeship had ceased. The exact period when he commenced bookselling is unknown, but he is said to have been the first who established a circulating library in Scotland. The library continued to exist till a comparatively recent period. His first shop, as we learn from the imprint of some of his books, was "at the sign of the Mercury, opposite to Niddry's Wynd"; but in 1726 he removed to a house at the east end of the Luckenbooths, and adopted for his sign the heads of Ben Jonson and Drummond of Hawthornden. In 1721 he published a collection of his poems which was so liberally subscribed for that he is said to have cleared by it 400 guineas. These poems had originally appeared on separate broadsheets and sold for a penny each. In 1724 the first volume of 'The Tea-Table Miscellany,' a collection of songs appeared, which was soon followed by two others. Shortly afterward he brought out 'The Evergreen, being a Collection of Scots Poems wrote by the Ingenious before 1600,' which was equally successful. In 1725 appeared his famous pastoral, 'The Gentle Shepherd.' Its success was instantaneous, and edition followed edition with great rapidity. In 1728 a second quarto volume of his poems appeared; and his 'Thirty Fables,' undoubtedly the best of Ramsay's lesser productions. He was now at the height of his celebrity, and his shop was the common resort of the literary characters and wits of Edinburgh. He spent the last 12 years of his life in a quaint house he had built on the north side of Castle Hill, although he did not give up his shop until within three years of his death. He was buried in Greyfriars' Churchyard, where a monument has been erected. Another monument, erected in 1865, stands in Princes' Street Gardens. Consult 'Life' by Smeaton (1800); Graham, 'Scottish Men of Letters in the 18th Century' (1901).

Ramsay, Allan, Scottish portrait painter, son of the preceding: b. Edinburgh 1713; d. Dover 10 Aug. 1784. He studied art in London and in Italy, and by 1758 had achieved a high reputation. George III. appointed him principal court painter. Walpole regarded some of his portraits of women superior to Reynolds'. He painted portraits of Gibbon, Chesterfield, Hume, Rousseau, and many others, now in the National Portrait Gallery and the gallery at Edinburgh.

Ramsay, Sir Andrew Crombie, Scottish geologist: b. Glasgow, Scotland, 31 Jan. 1841; d. Anglesey, England, 9 Dec. 1891. In 1841 he joined the geological survey, with which he was connected until 1881. He became professor of geology at University College, London, in 1848; was lecturer at the School of Mines 1851; president of the Geological Society 1862; and director-general of the Geological Survey and the Museum of Practical Geology 1872-81. He was popular as a lecturer, and held the theory that many lake basins are the result of glacial excavations. As a geologist he devoted himself to stratigraphy to the exclusion of palæontology and petrography. His works include: 'Old Glaciers of North Wales and Switzerland' (1860); 'The Physical Geology and Geography of Great Britain' (1872); etc.

Ramsay, Andrew Michael (CHEVALIER RAMSAY), Scottish scholar: b. Ayr, Scotland, 9 June 1686; d. Saint Germain-en-Laye, France, 6 May 1743. He was educated at the universities of Edinburgh and Saint Andrews and being deeply interested in theological matters he went to Leyden where he formed a friendship with the mystic Poirret through whom he visited Fenelon, archbishop of Cambrai, in France in 1710. The latter took a deep interest in Ramsay, succeeded in converting him to the Roman Catholic faith, and kept him with him until his death in 1715 when he bequeathed to Ramsay his papers. Ramsay then became tutor to the Duc de Château-Thierry and subsequently acted in the same capacity to the sons of the Pretender, Francis Edward, at Rome. He visited England in 1730, was elected to the Royal Society and on his return to Paris became tutor to the Vicomte de Turenne. His writings were published in excellent French, but though of considerable merit and very popular in his day, are now rarely read. They include: 'Essai Philosophique sur le Gouvernement Civil' (1721); 'Vie de Fénelon' (1723); 'Poems' (1728); 'L'Histoire du Vicomte de Turenne' (1735); etc.

Ramsay, David, American physician and historian: b. Lancaster County, Pa., 2 April 1749; d. Charleston, S. C., 8 May 1815. He studied medicine and practised in Charleston, where he soon acquired celebrity. He was a field-surgeon in the Continental army, was elected to the State legislature in 1776, was a prisoner of the British in 1780-1, and in 1772-6 served in the Continental Congress, acting as president in 1775-6. He was a member of the South Carolina legislature in 1801-15 and was president of the State senate when he was killed by a lunatic. He labored zealously with his pen to promote the cause of the American independence, and among his publications are: 'The History of the American Revolution' (1785); 'The Life of Washington' (1789); 'The History of South Carolina' (1809); 'Universal

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History Americanized, or an Historical View of the World, from the Earliest Record to the 19th Century (12 vols. 1816-17); etc.

Ramsay, Edward Bannerman, Scottish Episcopal clergyman: b. Aberdeen 31 Jan. 1793; d. Edinburgh 27 Dec. 1872. He was the son of Alexander Burnett, but adopted the name of his grand-uncle, Sir Alexander Ramsay, by whom he was brought up. Educated at Cambridge, he took holy orders and went to Edinburgh in 1823 as a clergyman of the Scottish Episcopal Church, becoming dean of the diocese in 1846. He is best known by his 'Reminiscences of Scottish Life and Character' (1858), which has had great popularity. Among other works by him are: 'Lectures on Handel' (1862); 'Pulpit Table-Folk' (1868).

Ramsay, Francis Munroe, American naval officer: b. Washington, D. C., 5 April 1835. He was appointed midshipman in 1850, was graduated from the United States Naval Academy in 1856, and in the Civil War participated in the engagements at Haines' Bluff, Yazoo River, Milliken's Bend, and later commanded the gunboat Unadilla of the North Atlantic Squadron. He was superintendent of the United States Naval Academy in 1881-6, was promoted rear-admiral in 1894, served as chief of the Bureau of Navigation in 1889-97; and in the latter year was retired on reaching the age limit.

Ramsay, Nathaniel, American soldier: b. Lancaster County, Pa., 1751; d. 25 Oct. 1817. He was graduated from Princeton in 1767, studied law, was admitted to the bar in 1771, and in 1776 entered the Continental army with rank as lieutenant-colonel. He greatly distinguished himself at the battle of Monmouth in 1778, when he with Colonel Stewart checked the advance of the British while Washington rallied the main army. He was severely wounded, taken prisoner, and held until 1780 when he was shortly afterward retired. With the exception of 1786-7, when he was a member of Congress from Maryland, he saw no further public service.

Ramsay, Sir William, Scotch chemist, nephew of Sir A. C. Ramsay, the geologist: b. Glasgow 2 Oct. 1852. He was educated at Glasgow and Tübingen, was assistant in the "Young" chemical laboratory 1872-4, and at Glasgow University 1874-80, and, after seven years as professor of chemistry at University College, Bristol (six as its principal), in 1887 he became professor of chemistry at University College, London. A member of most of the royal academies, philosophical, physical and chemical societies of the world, he won his chief repute for his study of rare gases and their discovery; with Lord Rayleigh in 1894 he discovered argon (q.v.), and alone isolated helium, krypton, neon and xenon (qq.v.). In the investigation of the nature and properties of radium he took a prominent part, and in November 1903 claimed that he had proof that helium is the gaseous emanation of radium (q.v.)—a discovery which would upset the law of the stability of the elements. He was made K.C.B. in 1902. He wrote 'The Gases of the Atmosphere, the History of their Discovery' (1896).

Ramsay, William Mitchell, Scottish archaeologist and historian: b. Glasgow 15 March

1851. He was educated at the universities of Aberdeen, Oxford, and Göttingen, was Oxford traveling student in 1880, and from that date onwards has traveled extensively in Asiatic Turkey. In 1885 he was appointed to the chair of classical archaeology at Oxford, and since 1886 has been professor of humanity (Latin) in the University of Aberdeen. He has made a special study of the geography and topography of Asia Minor, and among his works are: 'The Historical Geography of Asia Minor' (1890); 'The Church in the Roman Empire before A.D. 170' (1893), dealing with St. Paul in Asia Minor and the early persecutions of the Christians; 'The Cities and Bishoprics of Phrygia' (1895-7); 'St. Paul the Traveler and the Roman Citizen' (1895); 'Impressions of Turkey' (1897); 'Was Christ Born at Bethlehem?' (1898); 'Historical Commentary on the Epistle to the Galatians' (1899); 'The Education of Christ' (1902).

Ramsden, rām'z'dēn, Jesse, English mechanist and optician: b. Halifax, Yorkshire, 6 Oct. 1735; d. Brighton, Sussex, 5 Nov. 1800. He was apprenticed to a cloth-worker, but subsequently applied himself to engraving, and in the course of his employment having to engrave several mathematical instruments, finally constructed them himself. He opened a shop in the Haymarket, whence he removed to Piccadilly, where he remained until his death. Ramsden obtained a premium from the board of longitude for the invention of a machine for the division of mathematical instruments. He also improved the construction of the theodolite, the pyrometer for measuring the dilatation of bodies by heat, the barometer for measuring the height of mountains, the refracting micrometer and transit instrument and quadrant. He made great improvements in Hadley's quadrant and sextant, reducing the limits of error from 5' to 30"; and procured a patent for an amended equatorial. He was chosen a fellow of the Royal Society in 1786, and such was his reputation that his instruments were bespoken from every part of Europe. He received the Copley medal from the Royal Society in 1795 in recognition of the importance of his various inventions.

Ramseur, rām'sér, Stephen Dodson, American soldier: b. Lincolnton, N. C., 31 May 1837; d. Cedar Creek, Va., 19 Oct. 1864. He was graduated from West Point in 1860 and was assigned to garrison duty at Fortress Monroe. At the outbreak of the Civil War he resigned from the United States army to enter the Confederate service with rank as major of artillery. He served in the peninsular campaign, was later attached to "Stonewall" Jackson's command, performed gallant service at Chancellorsville and at Gettysburg in his capacity of brigadier-general, and was conspicuous for bravery in the battle of the Wilderness. In 1864 he received temporary rank as major-general, was engaged in the Shenandoah campaign, and was fatally wounded at the battle of Cedar Creek, where he was captured while covering the retreat of the Confederate forces.

Ramsey, rām'zī, Alexander, American politician and cabinet officer: b. near Harrisburg, Pa., 8 Sept. 1815; d. Saint Paul, Minn., 22 April 1903. He took a partial course at Lafayette College (Easton, Pa.), studied law at Carlisle,

Pa., was admitted to practice in 1839, in 1841 was elected chief clerk of the Pennsylvania house of representatives, and in 1843-7 was a Whig representative in Congress. In 1848 he was chairman of the Whig State committee, and on 2 April 1849 was appointed governor of Minnesota, established as a territory 3 March 1849. He concluded treaties with the Ojibways and Sioux in 1851, and a second treaty with the Ojibways in 1853. In 1855 he became mayor of Saint Paul, in 1859 was elected governor of the State of Minnesota, being the Republican candidate for the first State campaign, and by re-election held the post until his resignation 10 July 1863. He then served in the United States Senate two terms, ending in 1875. While in the senate he visited France in the effort to secure a cheaper rate of international postage. In 1879-81 he was secretary of war in Hayes' cabinet. He was a leading spirit of the Minnesota Historical Society, of which he was the first president (1849-63). He was the first Civil War governor to offer volunteers to Lincoln.

Ramsgate, rāmz'gāt, England, on the Isle of Thanet, in the County of Kent, four miles from Margate, is a seaport and popular seaside resort. It is situated in the valley between chalky cliffs and has a fine stretch of sandy beach. The chief places of interest are the theatre, music-hall, assembly-room, iron promenade pier, and churches. There is an excellent harbor, extensive bathing establishments; of historical interest are: an ancient Anglo-Saxon graveyard on Ossengal Hill, about one mile from the town; Pegwell Bay, the landing place of Hengist and Horsa, and Cliffs' End, where a cross marks that of Saint Augustine. There is some ship-building, rope-making and a considerable fishery.

Ramus, rām'mūs, **Petrus**. See RAMÉE, PIERRE. **Ra'na**. See FROG.

Ranavalona III., former queen of Madagascar: b. about 1861. She succeeded her aunt, Ranavalona II., in 1883 and in that year married the prime minister Rainilaiarivony who had been prince consort to her aunt. She was only nominally queen as the government had been controlled by the prime minister since 1864. The French succeeded in establishing a protectorate over the island in 1895, Ranavalona retained a nominal sovereignty until 1897 when the island was declared a French colony and the queen was deposed and exiled to Algeria.

Ranc, rānk, **Arthur**, French politician and author: b. Poitiers, 20 Dec. 1831. He was educated at the college in Poitiers; studied law in Paris in 1853; became involved in the disorders of the democratic party, was arrested and deported to Africa. Returning to Paris after the amnesty of 1859, he contributed to the 'Courrier du Dimanche,' the 'Nain Jaune,' the 'Journal de Paris' and other journals. For certain articles written for the 'Nain Jaune' he was imprisoned for four months. Under Gambetta he became director of police and in 1871 was elected to the National Assembly, but, owing to his disagreement with the arrangements for peace he resigned and was elected a member of the Commune. He resigned from that body on account of its violence. In 1873 he again became a member of the National Assembly. Later he was impeached for the part he had played

during the Commune, and in 1875 during his absence in Belgium was condemned to death *in contumaciam*. The amnesty of 1879 allowed his return to France, and in 1881 he became deputy from the Seine and in 1891 a senator. He wrote a political romance, 'Sous l'Empire' (1872), also 'De Bordeaux à Versailles' (1877); 'Le Roman d'une Conspiration' (1868).

Rancagua, rān-kāg'wā, Chile, the capital of the province of O'Higgins, 45 miles by rail south of Santiago. It is an agricultural centre with an active domestic trade. The Spaniards here won an important victory over the revolutionary forces in 1814.

Rancé, rān-sā, **Dominique Armand Jean le Bouthillier de**, founder of the reformed order of La Trappe: b. Paris 9 Jan. 1626; d. 26 Oct. 1700. At 11 he was appointed canon of Notre Dame, and at 13 wrote a commentary on the Odes of Anacreon. After being graduated at the Sorbonne, he was ordained priest (1651) and before long was preferred to no fewer than six benefices. Residing at Paris, in receipt of a large income in addition to his private fortune, he gave himself up to a life of dissipation. In 1657, however, a change took place in his manner of life, and he determined to enter the cloister. He disposed of his estate of Veret, near Tours, applying the proceeds to religious purposes, and demitted all his benefices except the priory of Boulogne and the abbey of La Trappe. Retiring to the latter place in 1664, he began the strictest reforms. (See LA TRAPPE.) In consequence of his growing infirmities he resigned his charge of the abbey in 1695. Consult Marsoillier, 'Vie de Rancé' (1703); Gaillardin, 'Trappistes' (1844); Pfannenschmidt, 'Geschichte der Trappisten' (1873).

Ranching, a term derived from the Spanish-American word "rancho," originally meaning a place where herdsmen eat and sleep, but gradually extended to mean a grazing farm. Some of these ranches are of vast extent, especially in Old Mexico and in South America, and include hundreds of square miles. In Texas, Colorado and other western States and Territories, also, there are very large ranches, from which come the supplies of cattle for the American and foreign markets. With the growth of population there has been a marked reduction in great individual holdings of land, but some of the cattle-farms are still very extensive. The cattle are herded by a mixed class of men known as cowboys, which includes students from college, rough and honest frontiersmen, and others with a record that has driven them from places where they are better known. It was chiefly from the cowboy element that President Roosevelt recruited his Rough Riders for the Spanish-American war.

The cowboys round up the cattle once or twice a year, when the steers three years old are separated from the main herd and sent to market, and the calves are branded. The cattle of the ranches have been much improved within recent years by crossing with domestic breeds.

Rand, rānd, or **Witwatersrand**, South Africa. See WITWATERSRAND; TRANSVAAL COLONY.

Randall, rān'dāl, **Alexander Williams**, American legislator: b. Ames, N. Y., 31 Oct.

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1819; d. Elmira, N. Y., 25 July 1872. He studied law, was admitted to the bar and in 1840 established a law practice at Waukesha, Wis. He was appointed postmaster there and in 1847 was a member of the convention which framed the State constitution. In 1855 he was elected to the State legislature, was judge of the 2d district in 1856, and in 1857-61 was governor of Wisconsin, rendering important aid in raising troops for the Union army. In 1861-2 he served as minister to Italy, was assistant postmaster-general in 1862-6, and postmaster-general in 1866-9. He then retired from public life and engaged in law practice at Elmira until his death.

Randall, Emilius Oviatt, American author: b. Richfield, Ohio, 28 Oct. 1850. He was graduated from Cornell University in 1874, studied law in the Ohio State University; was admitted to the bar in 1890 and became professor of law at the Ohio State University in 1893. He was appointed secretary of the Ohio State Archaeological and Historical Society in 1894, and official reporter of the Ohio supreme court in 1895. He was editor of 'Bench and Bar of Ohio'; 'Ohio State Reports of the Supreme Court Decisions' (17 vols.); and since 1897 has also edited the 'Ohio Archaeological and Historical Quarterly.' He has written: 'History of the Separatist Party of Zoar' (1899); 'History of Blennerhassett' (1899).

Randall, George Morton, American military officer: b. Ohio 8 Oct. 1841. At the outbreak of the Civil War he entered the Union army, where he received a commission as 2d lieutenant. He received steady promotion, was distinguished for gallantry at Antietam and Petersburg, and was mustered out of the volunteer service in 1865 with the rank of lieutenant-colonel. He was commissioned captain in the regular army in that year, promoted colonel in 1890 for gallant services in the Indian warfare in Arizona in 1873-4; commissioned brigadier-general of volunteers at the outbreak of the Spanish war in 1898, and on the reorganization of the regular army in 1901 received rank as brigadier-general.

Randall, James Ryder, American journalist and poet: b. Baltimore, Md., 1 Jan. 1839. He was educated at Georgetown College, D. C., taught for a while in a Louisiana college, and then turned to journalism. In 1861 he wrote 'Maryland, My Maryland,' a song which when set to music became, next to 'Dixie,' the most popular of the Confederate war-songs and is considered by many to be the best American martial lyric. None of his other songs achieved the fame of this, but several of them are of notable excellence. Among them are: 'Stonewall Jackson,' and 'There's Life in the Old Land Yet.' After 1866 he was for many years the editor of the 'Constitutionalist' of Augusta, Georgia.

Randall, Samuel Jackson, American statesman: b. Philadelphia 10 Oct. 1828; d. Washington, D. C., 12 April 1890. Educated in the schools of his native city, he began life as a silk merchant's clerk and later entered into partnership in a firm of wholesale iron merchants. But politics was more attractive to him than business. He served four years as member of the city council and in 1858 was elected to the

State senate. He enlisted with the City troop of Philadelphia at the beginning of the Civil War and served under Gen. Thomas' command in the 2d United States cavalry. He was promoted to orderly sergeant, then quartermaster, and finally captain of his company. During the battle of Gettysburg he was advanced to provost-marshal. In 1862 he was elected to Congress and was a member of that body for 28 years. The first eight years of his career in Congress were uneventful; but in the 43d Congress he served with Blaine, Garfield, Banks, and S. S. Cox on the committee on rules, and took the lead in the opposition to the Force Bill in order to defeat its passage as law and secure for himself the leadership of the Democratic party in Congress. He was elected Speaker of the House at the 2d session of the 44th Congress and re-elected by the 45th and 46th; hence it fell to him to preside during the dispute over the Presidential election of 1876. He was not in sympathy with the settlement of the difficulty by means of an electoral commission. Although always a Democrat, he took the opposite view to that of his party on the subject of protection at the period when tariff discussions were uppermost in Congress. He was an indefatigable worker and never shirked the arduous labor of committees, insisting always on economy and honesty in the management of public affairs. Hence he served as an immense safeguard of the national treasury.

Randegger, rân'dëg-gër, Alberto, Austro-English composer and conductor: b. Trieste 13 April 1832. He studied pianoforte under Lafont and composition under L. Ricci, and before he was 20 was known as composer of several masses and two ballets. His next work was an opera, 'Il Lazzarone,' to a libretto by Rossi. He became musical director in various Italian theatres, and brought out his second opera, 'Bianca Capella,' at Brescia in 1854. In that year he removed to London, where he has since resided, becoming naturalized. He has been teacher and director of the Royal Academy of Music, conductor of Italian opera at Covent Garden, and of concerts at Queen's Hall and the Norwich Festival. A comic opera, 'The Rival Beauties,' was produced in 1864. He was made Knight of the Crown of Italy in 1892.

Randers, rân'dërs, Denmark, in Jutland, eight miles from Randers Fjord, an important port, whose chief exports are butter and eggs; chief imports sugar, petroleum, coal, and iron. Its celebrated gloves, its manufactures of hosiery, cutlery, railway carriages, calico-printing works, and distilleries are the chief industries. Pop. about 22,000.

Randolph, rân'dölf, Alfred Magill, American Protestant Episcopal bishop: b. Winchester, Va., 31 Aug. 1836. He was graduated at William and Mary College in 1855 and at the Virginia Theological Seminary in 1858, and took priest's orders in 1860. He was rector of St. George's Church, Fredericksburg, Va., 1860-2, chaplain in the Confederate army 1863-5, and rector of Emmanuel Church, Baltimore, Md., 1867-83. In the latter year he was elected coadjutor-bishop of Virginia. In 1892 the diocese was divided and he then became bishop of southern Virginia. He has published 'Reason, Faith, and Authority in Christianity' (1902).

RANDOLPH

Randolph, Edmund Jennings, American statesman: b. Williamsburg, Va., 10 Aug. 1753; d. Clarke County, Va., 13 Sept. 1813. He was educated at William and Mary College and afterward admitted to the bar. He was Virginia's first attorney-general, was member of Congress 1779-82 and governor of Virginia 1786-8. He was a member of the convention that framed the Federal constitution, though he did not approve or sign the document when completed. However, he urged Virginia to accept it, feeling the necessity of union of the States. He was a leader in the work of codifying the Virginian laws begun in 1788. In 1789 Washington appointed him attorney-general, and in 1794 he succeeded Jefferson as secretary of state. During the pending of the Jay treaty, Fauchet, the French minister to the United States, sent home some despatches to his country which were intercepted by an English ship and through the English minister were transmitted to Washington. They were kept by the President for eight days before their contents were disclosed to Randolph. Feeling that others had been consulted regarding the matter before he was apprised and that he must consequently be prejudged, he resigned his office after denying the allegations of the despatches. He retired to Virginia and resumed the practice of the law, but his public career was blighted and his memory bore the stain of the accusations against him until his vindication was presented by Moncure D. Conway in an article, 'A Suppressed Statesman,' in *Lippincott's Magazine* for September 1887, followed by a biography, 'Omitted Chapters of History Disclosed in the Life and Papers of Edmund Randolph' (1888).

Randolph, John, of Roanoke, American statesman: b. Cawsons, Chesterfield County, Va., 2 June 1773; d. Philadelphia 24 June 1833. He was of an old and wealthy Virginia family. His father died young, and his mother married St. George Tucker, who directed his early education. Later he attended the grammar school of William and Mary College; in 1787 went to Princeton for a few months, and the following session to Columbia College, which ended his academic training. In spite of his protestations of ignorance he was well educated, wrote and reasoned well. He read law and began to practise, but entered into politics, and in 1799 was elected to Congress on a platform denouncing the Alien and Sedition laws. Randolph was in the House of Representatives 1799-1813, 1815-17, and 1819-25. He was a member of the Senate 1825-29, and in 1829 was a member of the Virginia Constitutional Convention. In Congress he soon became the leader of the Democratic-Republican opposition, and after the defeat of the Federalists, was the leader of the administration party, but soon fell out with Jefferson, and became an independent with a few followers called "Quids." Throughout his public career Randolph was a consistent, strict constructionist. In his first speech he advocated a reduction of the "mercenary" army; he led in the impeachment (1804-5) of Justice Chase, of the Federal District Court; he denounced the settlement of the Yazoo frauds; and was the enemy of fraud and corruption in every form. Brought up in the midst of war, he hated it, opposing all measures leading to the War of 1812, and his opposi-

tion to the administration cost him his seat in 1813. Returned to Congress in 1815, he strongly opposed the national reaction that followed the War of 1812. He disliked slavery, but denounced the Missouri Compromise as a surrender of principles by both sides. He invented the term "dough faces," as applied to Northern men who made compromises with slavery for reasons of expediency. He supported Jackson for the Presidency, and denounced the Adams-Clay understanding as "a combination of Puritan and blackleg." A duel with Clay followed (1825), in which Randolph threw away his fire and offered Clay his hand. In 1830 Jackson appointed him minister to Russia. Resigning because of ill health, Randolph returned to America (1831) and opposed Jackson in the Nullification controversy. Re-elected to Congress in 1832, he died before taking his seat. Randolph was a strange compound of contradictory elements. At times he was a deist; oftener an emotional Christian. He was a far-sighted statesman, an eloquent speaker, a master of satire and vindictive; at times he spoke nonsense. Eccentric and irritable in public, he was fond of children and was loved by them. By his will he emancipated his 318 slaves, providing for their support. With clearer vision than most of his contemporaries, he foresaw the grave danger to the South from the slavery question in politics and pointed out the course which that section must follow. He was never married, his fiancée, the beautiful Maria Ward, having broken her engagement with him to marry his cousin, Peyton Randolph. An aristocrat, he believed in the democratic theories of the French Revolution, but admired Edmund Burke. In his later years, his mind was affected by disease and the use of drugs to deaden pain, and by domestic troubles. In personal appearance Randolph was tall, very slender, with a dark, keen face, and long thin fingers, which he pointed or shook at his opponents when speaking. "Little Jack" was a beautiful boy; John Randolph was an ugly man. Consult: Garland, 'The Life of John Randolph of Roanoke' (1881); Henry Adams, 'John Randolph' (1882); Trent, 'Southern Statesmen of the Old Regime' (1898).

WALTER L. FLEMING,
Professor of History, West Virginia University.

Randolph, Peyton, American patriot, president of the 1st Continental Congress: b. Williamsburg 1723; d. Philadelphia 22 Oct. 1775. He was graduated at William and Mary College, and, sent to complete his education in England, studied law at the Temple. In 1748 he became king's attorney for the colony, and the same year was chosen a member of the House of Burgesses. He was chairman of a committee authorized to revise the laws of the colony, and was among the most active and influential members of the assembly. In 1764 the Virginia House of Burgesses voted an address to the king against the passage of the Stamp Act, which Randolph drew up. On 12 April 1766 he was made speaker of the House of Burgesses, and resigned his office of attorney-general. In the measures of opposition to the English he now took a conspicuous part. In March 1773, on the reception of copies of an address and resolution from the Massachusetts assembly, Randolph was prominent in urging instant and bold action. In the convention which



John Randolph

RANDOLPH — RANDOLPH-MACON SYSTEM

met in August 1774, at Williamsburg, he presided, and was one of the delegates elected to the Continental Congress appointed to meet in Philadelphia in the following September. On the assembling of that body he was unanimously elected its president. In 1775 he presided over the second convention of Virginia and was speaker of the House of Burgesses.

Randolph, Thomas, English poet and dramatist: b. Houghton, Northamptonshire, 15 June 1605; d. Blatherwyke, Northamptonshire, 17 March 1635. He was educated at Cambridge, and was admitted to a fellowship, began early to write, and gained the friendship of Shirley and Ben Jonson, who adopted him among his poetic "sons." He seems to have lived a boisterous life, which was doubtless the cause of his early death. He left a number of bright, fanciful poems, and was author of several dramas successfully performed by the university students. 'Aristippus, or the Jovial Philosopher' and 'The Conceited Peddler' were published in 1630, the first a satire on university education, the latter a monologue in the style of Shakespeare's 'Autolycus.' He also wrote: 'The Muses' Looking Glass' and 'Amyntas,' published posthumously with his poems (1638); and 'Cornelianum Dolium' (1638) and 'Hey for Honesty' (1651) are credited to him. His collected works were edited by Hazlitt (1875).

Randolph, Thomas Jefferson, American legislator: b. Monticello, Albemarle County, Va., 12 Sept. 1792; d. Edge Hill, Albemarle County, Va., 8 Oct. 1875. He was for several years a member of the State legislature of Virginia, where he introduced in 1832 a bill for the gradual abolition of slavery, and in 1842 another for the reform of the taxes, which was passed, and proved of assistance in placing the State on a sound financial basis. In 1851-2 he was a member of the convention for the revision of the Virginia Constitution, in Civil War time was a firm supporter of the Confederacy, and in 1872 presided over the National Democratic convention which nominated Horace Greeley for the presidency. As literary executor he edited the 'Life and Correspondence of Thomas Jefferson' (1829); and he wrote also 'Sixty Years' Reminiscences of the Currency of the United States.'

Randolph, Vt., town in Orange County; on the Central Vermont railroad; about 22 miles south by west of Montpelier. The town includes several villages. It is in an agricultural and lumbering region and its industries are connected largely with farming and lumbering. It has wooden ware factories, flour and lumber mills, and creameries. Its most noted institution is the Randolph State Normal School. It has a free public library. Pop. (1890) 3,232; (1900) 3,141; (1910) 3,191.

Randolph Plan, in American political history, the name given the scheme of a Federal Constitution proposed in the Convention of 1787 by Edmund Randolph of Virginia. It contained 15 resolutions and proposed a correction of the Articles of Confederation; representation by population in two branches of Congress, the first chosen by the people, the second by State Legislatures; congressional control of taxation and commerce; congressional veto of State enactments; that Congress should choose the

executive; that the executive with part of the judiciary should have a limited veto on acts of Congress, and other less important provisions. The plan was favorably reported and many of its suggestions were used in the drafting of the Constitution.

Randolph-Macon (mă'kôn) System of Colleges and Academies, a group of five institutions in Virginia, comprising: (1) Randolph-Macon College at Ashland, a college for men; (2) Randolph-Macon Academy at Bedford City; and (3) Randolph-Macon Academy at Front Royal, preparatory schools for boys; (4) Randolph-Macon Woman's College at Lynchburg; (5) Randolph-Macon Institute at Danville, a preparatory school for girls. These institutions are under the control of one board of trustees, which is self-perpetuating. The original institution is the college for men at Ashland, which was established under the auspices of the Methodist Episcopal Church, South, and received its charter from the Virginia legislature in 1830, thus being the oldest Methodist college in America. It was located near Boydton, Mecklenburg County, Va., and opened to students in 1832. The college obtained no permanent endowment until shortly before the Civil War, and was closed during the war. Much of the endowment was also rendered worthless, and the college reopened in 1866 under serious embarrassment. In 1868 its site was changed to Ashland, Va., and since that time its work has been successful and influential. The first of the affiliated schools was the Academy at Bedford City, founded in 1890; the Academy at Front Royal was established in 1892, and the Woman's College in 1893; the Institute at Danville was affiliated with the system in 1897.

The Randolph-Macon College at Ashland offers courses leading to the degrees of A.B. and A.M., graduation with distinction in four subjects additional to those required for the degree of A.B., is required for the degree of A.M. The A.M. courses are elective, and the elective system prevails to a limited degree in the A.B. course. Six students' aid funds are provided, four of which are for ministerial students, and several scholarships, the largest of which has a fund of \$10,000. Two literary societies are maintained by the students for literary and oratorical exercises. The buildings include Pace Lecture-Room Building, the Chemical Laboratory, Duncan Memorial Chapel, the Library, the Gymnasium, the Pettyjohn Hall of Science, and eight large dormitories. The library contained in 1910, 11,000 volumes. The grounds and buildings are valued at \$95,000; the productive funds amounted to \$210,000 in 1910, and the annual income to \$19,000. The students numbered 147, and the faculty 18.

The Randolph-Macon Woman's College offers courses leading to the degrees of A.B. and A.M. One year of graduate work in courses elected by the student is required for the master's degree. For the A.B. course the work of the first two years is prescribed, the last two years is largely elective; the electives are arranged in eight groups, one course in each group being the free choice of the student. Courses in music are offered; one course in the history of music is open to all college students and counts toward the A.B. degree; and a com-

RANGE — RANK

pletion of the course in either piano, organ or vocal music counts three hours toward the degree. The college occupies two large buildings, the main building and the Jones Memorial Library; the library contained 9,000 volumes in 1910. In 1910 the productive funds amounted to \$210,000, the annual income was \$158,000. The students numbered 516 and the faculty 42.

Range, (1) in gunnery, the horizontal distance to which a projectile is thrown. Strictly, it is the distance from the muzzle of the gun to the second intersection of the trajectory with the line of sight. A cannon lying horizontally is called the right level or point-blank range; when the muzzle is elevated to 45° it is called the utmost level. (2) In music, the whole ascending or descending series of sounds capable of being produced by a voice or instrument; the compass or register of a voice or instrument. (3) In natural science, the geographical limits within which an animal or plant is now distributed, and the limits in point of time within which it has existed on the globe. The first is called range in space, and the second range in time. In the case of marine animals, as the *Mollusca*, there is also a range of depth, as measured by the number of fathoms which constitute their superior and inferior limits. (4) As a nautical term: the length of cable a little in excess of the depth of water, ranged on deck ready to run out when the anchor is let go. Also a large cleat in the waist for belaying the sheets and tacks of the courses.

Range Finder. See FORTIFICATION.

Rangeley (rānj'li) Lakes, in Maine, near the western boundary; one of the lakes, Umbagog, is on the boundary between Maine and New Hampshire. The principal lakes are Umbagog, Richardson, Molechunkemunk, Mooselucmaguntic, Rangeley, and Kennebago. A number of small bodies of water are connected with the lakes mentioned, and all are joined by short streams. The Rangeley Lakes are the headwaters of Androscoggin River (q.v.). They are noted for the wild and picturesque scenery, and the abundance of fish and game. The region is a favorite summer resort. Two railroads enter this section, one terminating at the town of Rangeley on Rangeley Lake, and the other at Bemis on Mooselucmaguntic Lake.

Ranger, rān'jēr, **Henry Ward**, American painter: b. Western New York 1858. He never attended an academy of art, but traveled through France, England, and Holland for several years, and returning to the United States was elected Associate of the National Academy of Design. Among his pictures are 'The Top of the Hill' (in the Corcoran Gallery); 'East River Idyll' (in the Carnegie Gallery); 'Pasture Lot'; 'Morning at High Bridge'; 'Bradley's Mill Pond.' Other of his pictures are marines, and as a landscape painter his works are fresh, vigorous and finely colored.

Rangoon, rān-goon', Burma, chief town and principal seaport of Lower Burma, on the left bank of the Hlaing or Rangoon River, in the Pegu Division, covers an area of 22 square miles, and is populated by Hindus, Mohammedans and Christians. The town occupies a long stretch of high land, incorporating villas whose spacious grounds lend to certain parts

almost a rural aspect. The wide streets are virtually boulevards bordered on either side by trees. The town is of recent growth, dating from about 1852. Among buildings may be mentioned the cathedrals, churches, government buildings, town-hall, law-courts, custom-house, hospital schools and colleges, and museum. The city enjoys most of the modern conveniences, including a good water supply. There is railway communication with Mandalay and Prome. A large foreign and inland commerce is also carried on by waterways. The main exports are rice and timber, besides raw cotton, precious stones, ivory, horns, and a variety of other articles. Cotton and woolen goods, machinery, coals, silk, salt and sugar are imported. The annual exports exceed \$10,000,000. Rangoon was built in 1753 by Aloung-Choosa, the founder of the Burmese dynasty, and has since been the scene of many wars between Burmans and Peguans. The British restored it in 1825 to the Burmese, but annexed it in 1852. Pop. about 240,000.

Ranjit Singh, rŭn-jēt' sīng'h', founder of the Sikh kingdom in the Punjab, India: b. Gujranwala 2 Nov. 1780; d. 27 June 1839. His father was Maha-Singh, sirdar of Sukur-Chukkah. He lost both parents before he was 18, and though wholly without education set vigorously about consolidating and extending his power. At 20 he was appointed governor of Lahore by the Afghan Amir and calculated upon the fanaticism of the Sikhs for establishing his power over them. He secured European officers to organize his army, whose steadfastness and religious zeal Sir William Hunter has compared to the Ironsides of Cromwell. In 1809 he formed an alliance with the English through Charles Metcalfe, defining the Sutlej as the boundary between their respective territories, and to this engagement he always remained loyal. Having removed the danger of English combination with any of his native rivals, he actively pushed forward his conquests until his territory extended to and embraced Multán on the south, Pesháwar on the west and Kashmir on the north. He obtained from Sháh Shujá, a refugee in Lahore, the Koh-i-núr diamond that had been carried off by Nádír Sháh from Delhi. Dissensions followed his death as none of his sons was capable of continuing his rule. Consult Griffin, 'Ranjit-Singh' (1892).

Rank, in the army and navy, a grade of various officers established by law. The highest rank in the American army is general; in the navy, admiral. Next to general is lieutenant-general, then major-general, and next brigadier-general. In time of peace the highest army officer is usually a major-general, the titles of general and lieutenant-general being bestowed only as marks of special distinction. The same conditions apply to the ranks of admiral and vice-admiral. There is at present one admiral, Dewey, and no vice-admiral, the nearest officers in rank being rear-admirals. A bitter controversy between the friends of the late Rear-Admiral Sampson and of Rear-Admiral Schley as to who was in command at the victory of Santiago prevented either from being made vice-admiral. The lowest military commissioned rank is second lieutenant; in the navy, ensign. Brevet rank is the title of a rank superior to that

actually held, without its pay or emoluments. At the close of the Civil War nearly all colonels, with good records, were brevetted brigadier-generals.

Ranke, rān'kē, Leopold von, German historian: b. Wiehe, Thuringia, 21 Dec. 1795; d. Berlin 23 May 1886. His preliminary education at Donndorf and Schulpforta was followed by courses in theology and philology in Leipsic. From 1818 to 1825 he taught classics in the gymnasium at Frankfort, and then became professor of history at Berlin, largely because of the promise of his 'History of the Roman and Germanic Peoples from 1494 to 1535,' of which the first volume appeared in 1824. His coming to Berlin was the beginning of his study of Venetian history, which was chiefly due to his discovery of the valuable Relations of the Venetian ambassadors, a discovery which strengthened his belief in the importance of diplomatic and other documentary material. In 1827 he began the important study of civilization, first entitled 'Princes and Peoples of Southern Europe in the 16th and 17th Centuries,' and in its revised form called 'The Ottomans and the Spanish Monarchy in the 16th and 17th Centuries' (1877); and in the years immediately following wrote on the Servian Revolution (1829); 'The Conspiracy against Venice in 1618' (1831); and the lectures 'On the History of Italian Poetry' (1837). To the lectures delivered in 1833 may be dated the rise of the historical school known by his name; which, like the Heidelberg School, was Protestant in sympathy and impulses, but unpartisan in methods; its members include Waitz, best known for his studies of constitutional history, Giesebrecht, who wrote on the German Empire, von Sybel, author of the 'History of the French Revolution,' von Sybel's pupils, von Noorden and Maurenbrecher, and Dümmler, one of the editors of the 'Monumenta Germaniæ,' and Dove, Ranke's literary executor and one of the editors of volumes 7-9 of the 'History of the World.' From 1833 also dates the foundation of the 'Historisch-Politische Zeitschrift,' edited by Savigny, Ranke and others, and protesting against the extreme liberalism of the revolution of July; as well as the beginning of Ranke's great history of 'The Roman Popes in the Last Four Centuries' (1834-7; 10th ed. 1900), with its clear outline of the varied political and religious influences at work in Rome and its wonderful grasp of the meaning in a philosophic scheme of 'World-History' of the Papacy. It was followed and balanced by 'German History in the Time of the Reformation' (1839-47; 7th ed. 1894), and 'Twelve (originally Nine) Books of Prussian History' (1847-8; revised 1878-9), thus fulfilling in part his function as Prussian historiographer, a post to which he had been appointed in 1841. He was ennobled by the King of Prussia in 1865, and since 1858 had been president of the Munich Historical Commission. His academic activity ceased in 1871, but his work of research, authorship, and revision continued almost to the very day of his death. A monument was erected to him in Wiehe, in 1896.

He wrote 'French History, Especially in the 16th and 17th Centuries' (1852-61), 'English History in the 16th and 17th Centuries' (1859-67; revised and enlarged 1877-9), and

various studies in German history, among which the sympathetic 'History of Wallenstein' (1869; 5th ed. 1895) should be mentioned. But of the greatest importance as embodying Ranke's philosophical idea of universal history is the 'History of the World' (1880-8; 5th ed. 1896 sqq.), which is marked by thorough research, excellent critical judgment, and sharp, clear, and felicitous characterization, with a poetical vigor of style.

Ranke's complete works were edited by Dove; volumes 53 and 54 contain valuable autobiographical matter. Consult also: Dove's biography in the 'Allgemeine deutsche Biographie'; sketches by Sybel, in 'Histor. Zeitschrift,' vol. 56; Prutz, in 'Unsere Zeit' (1886), and his son F. v. Ranke, in 'Deutsche Revue' (1903); Lorenz, 'Ranke, die Generationenlehre und der Geschichtsunterricht' (1891); Guglia, 'Leopold von Ranke' (1893); Ritter, 'Ranke: Seine Geistesentwicklung und seine Geschichtsschreibung' (1896); Nalbandian, 'Ranke's Bildungsjahre und Geschichtsauffassung' (1901).

Rankin, Jeremiah Eames, American Congregationalist clergyman and educator: b. Thornton, N. H., 2 Jan. 1828; d. Cleveland, Ohio, 28 Nov. 1904. He was graduated from Middlebury College, Vt., in 1848 and entered the ministry, serving in various pastorates in Massachusetts, New York, and New Jersey. From 1889-1903 he was president of Howard University, Washington, D. C., resigning in the latter year. He was the author of numerous hymns, notably 'God be with You,' and also published 'Auld Scotch Mither and other Poems'; 'Christ His Own Interpreter'; etc.

Rankine, rān'kin, William John MacQuorn, Scottish scientist: b. Edinburgh 5 July 1820; d. Glasgow 24 Dec. 1872. He entered Edinburgh University, where he gained several prizes in the department of physics; in 1837 he took up civil engineering and in 1842 published his first book, 'An Experimental Inquiry into the advantage of Cylindrical Wheels on Railways.' In 1848 he began his researches in the domain of molecular physics, which occupied him at intervals throughout his life and form his chief claim to distinction in the domain of pure science. In 1855 he was appointed to the chair of engineering in Glasgow University, which position he held until his death. He published 'Manual of the Steam-Engine and other Prime Movers' (1859); 'Manual of Civil Engineering' (1861); 'Treatise on Shipbuilding, Theoretical and Practical' (1866); 'Machinery and Millwork' (1869). Consult memoir by Tait prefixed to his 'Miscellaneous Scientific Papers' (1881).

Ranney, William, American artist: b. Middletown, Conn., 9 May 1813; d. West Hoboken, N. J., 18 Nov. 1857. He learned drawing in Brooklyn, N. Y., and at the outbreak of the war with Mexico enlisted with the Texans. During the campaign he made sketches from the picturesque southwestern life, and after his return to Brooklyn, elaborated these into oil paintings of great interest, among which may be mentioned: 'Boone's First View of the Kentucky'; 'On the Wing'; 'Washington on His Mission to the Indians' (1847); 'Duck-Shooting' (Corcoran Gallery, Washington); 'The Sleigh Ride'; and 'The Trapper's Last Shot.'

RANSOM — RANUNCULACEÆ

Ransom, Matthew Whitaker, American soldier and legislator: b. Warren County, N. C., 8 Oct. 1826; d. 8 Oct. 1904. He was graduated from the University of North Carolina in 1847, was admitted to the bar the same year, and in 1852 was elected attorney-general but resigned in 1855. He entered political life and in 1858-60 served in the State assembly. He was untiring in his efforts to avert the Civil War, but when North Carolina seceded he entered the Confederate army and served with ability through the war, attaining the rank of major-general in 1865. Afterward he resumed his law practice, was elected United States senator in 1872 and served until 1895, when he was appointed minister to Mexico and served until 1897 when he returned to the United States and re-engaged in law practice at Weldon, N. C.

Ransom, Robert, American soldier: b. Warren County, N. C., about 1828. He was graduated from West Point in 1850, was brevetted 2d lieutenant of dragoons, and served in various parts of the West until appointed assistant instructor of cavalry tactics at West Point. He was made captain of the 1st cavalry 31 Jan. 1861, but resigned on 24 May and entered the Confederate army. He became colonel of the 9th North Carolina Confederate cavalry; in March 1862 was advanced to brigadier-general and on 26 May 1863 to major-general. In 1862 he commanded a brigade and the defenses near Kinston, N. C., and from April to June 1864 the Department of Richmond. He was in command in November 1864 of the subdistrict No. 2 of the department including South Carolina, Georgia, and Florida. Since the close of the war he has been express agent and city marshal of Wilmington, N. C., 1866-7; a farmer in Virginia 1874-8, and latterly a civil engineer in the service of the United States in various river and harbor improvements in Missouri and South Carolina.

Ransom, Thomas Edward Greenfield, American military officer: b. Norwich, Vt., 29 Nov. 1834; d. Rome, Ga., 29 Oct. 1864. He was educated at the Norwich University, studied civil engineering, and settled in Illinois, where he engaged as a civil engineer and a real estate agent. After the outbreak of the Civil War he became a lieutenant-colonel of volunteers in July 1861, and commanded a regiment at Shiloh in April 1862. He was promoted brigadier-general in January 1863; served under General Banks in the Red River expedition; and later joined Sheridan's army, took command of a division just before the capture of Atlanta, 2 Sept. 1864, and died as a result of overtaxing his strength while leading his troops in pursuit of Hood.

Ransom (from Latin, *redemptio*), the sum required to be paid to the captors of a prisoner of war in order to procure his release. The practice of redeeming prisoners of war by a ransom was a very common one not only in ancient times, but in modern times up to the end of the 18th century. As late as 1780 a treaty was concluded between France and Great Britain on the subject of exchange of prisoners, in which the various relations the different ranks bore to each other were specified, together with the sums required to be paid by way of ransom. A French vice-admiral or an English admiral was estimated as of equivalent value in the exchange of

prisoners to 60 sailors or private soldiers, as was also a French marshal or an English field-marshal. Ransom is now exacted only by brigands. Prisoners are generally retained until peace is restored, when they are released without ransom; or they may be exchanged during the progress of hostilities. Officers are frequently released during the war on pledging their word of honor to take no further active share in it.

Ransome, răn'sūm, Arthur, English physician: b. Manchester 11 Feb. 1834. He was educated at Trinity College, Dublin, Caius College, Cambridge, and studied medicine in London and Paris. He was lecturer on biology at Cambridge in 1857-61, professor of hygiene at Owens College in 1880-95, became lecturer on phthisis at the College of Physicians in 1890, and is a recognized authority in pulmonary diseases. He has published: 'Stethometry' (1876); 'Causes of Consumption' (1884); 'The Principles of Open Air Treatment of Phthisis and Sanatorium Construction' (1903); etc.

Ranters, a term not in use in the United States, but formerly applied in England to the Primitive Methodists, on account of the enthusiasm and earnestness which characterized their worship. While this is the recent application of the word, it was formerly used in the period of the English Commonwealth to indicate an alleged sect whose practices attracted public reprobation, and which was suppressed by the authorities.

Rantoul, răn'tool, Robert, Jr., American statesman: b. Beverly, Mass., 13 May 1805; d. Washington, D. C., 7 Aug. 1852. His father, who survived him for several years, was long a member of the State legislature. The son was educated at Harvard where he was graduated in 1826. He studied law in Salem, was admitted to the Essex bar in 1827, and for several years practised in Gloucester, which he represented in the legislature 1834-7 and distinguished himself there as a reformer and an advocate of the rights and interests of the common people. He exerted himself for the abolition of capital punishment, and made a report to the legislature on that subject. In 1837 he was appointed a member of the Massachusetts board of education, and gave much time and attention to the advancement of the system of public instruction. In 1843 he became collector of the port of Boston, and in 1845 was made United States district attorney. In 1851 he was elected United States senator to succeed Daniel Webster for the short remainder of his term; and having been prominent among opponents of the extension of slavery, the free-soilers of his district united with the Democrats in electing him to the United States house of representatives the same year. A volume of his speeches and writings with memoir appeared in 1854.

Ranuncula'ceæ, an order of herbs and shrubs. There are about 700 species, widely distributed in cold and temperate climates, and to a very limited extent in warm ones. All are more or less acrid while fresh, but usually lose this property upon being dried. A few have been reputed poisonous, others have been used in medicine, and several for food both for man and animals. The order is, however, chiefly noted for its ornamental species, many of which are widely popular garden flowers. The best

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known of these genera are probably *Aquilegia*, *Clematis*, *Anemone*, *Delphinium*, *Helleborus*, *Paonia*, *Nigella*, *Caltha*, *Aconitum*, *Actaea*, and *Ranunculus*. (See COLUMBINE; ANEMONE; LARKSPUR; PEONY; CLEMATIS; HELLEBORE). The type genus, *Ranunculus*, which includes about 200 species, is also cultivated. The garden or Asiatic ranunculus (*R. asiaticus*) is a native of western Asia, and has been cultivated for about 300 years for its brilliant single or double variously colored flowers. The lesser celandine (*R. ficaria*), a European species, is cultivated for its foliage, which is eaten like spinach, and for its tubers, which are served like potatoes. Several species of buttercups, notably *R. acris* and *R. repens*, are well-known weeds in pastures.

Ranz des Vaches, räns dā vāsh, the name of the national air which the herdsmen of the Alps in Switzerland sing or play on an instrument called the Alpenhorn, or horn of the Alps, when they drive out the herds. It consists of a few simple intervals, yet capable of producing a very striking effect in the echoes of the mountains. See NATIONAL HYMNS.

Raoul Rochette, rā-ool rō-shët. See ROCHETTE, DESIRÉ RAUL.

Raoult, rā-oo, **François Marie**, French chemist: b. Fournes, Nord, 10 May 1830; d. 1901. He was educated in Paris, where he received the doctorate in physical sciences in 1863. He went to the University of Grenoble to teach chemistry, was made professor in 1870 and dean of the faculty in 1889. In 1890 he was made correspondent of the Academy of Sciences. His researches were first in the field of electro-chemistry; later he turned to the discovery of the freezing-point of a great number of solutions and also the determination of the tension of vapors of volatile liquids.

Raoux, rā-oo, **Jean**, French painter: b. Montpellier 12 June 1677; d. Paris 10 Feb. 1734. He painted history, portraits and genre, and during his lifetime enjoyed a great reputation in France and was even elected to the Academy (1717). He has indeed painted some good landscapes in the style of Claude Lorraine, but his historical pictures are stogy and artificial. His portraits are said to have been good likenesses, and he is chiefly known nowadays for his portraits of fine ladies, on whom he bestowed the false and meretricious graces fashionable in his day. Many of his pictures were engraved.

Rap, familiar in the phrase "not worth a rap," a counterfeit Irish coin of the time of George I., which passed for a half-penny, though not really worth a fourth of that value. There was also a small Swiss coin called "rappen," worth a centime.

Rape, an annual herb (*Brassica napus*) of the order Cruciferae. It is a native of the Old World, where it has long been cultivated for its foliage and its seed, the former of which is an important stock food, the latter, a source of colseed oil. It resembles the turnip in foliage, but grows taller and lacks the turnip-like root. In America it is not grown for its seed at all, but toward the end of the 19th century became an important soiling and forage crop for sheep, and beef cattle. It is usually sown after mid-

summer upon any good soil, and is especially popular in cool climates because it will stand considerable cold without injury.

Rape, a word derived from German "raffen" and old English "rap," to seize and carry away, and meaning in law the crime of having carnal knowledge of a woman without her consent and by force. This has always been regarded as one of the highest crimes, and is still punished by death in some American States; in others by long terms of imprisonment. In the case of a female who has reached the age of consent, and who is not an idiot, the element of force is essential to constitute the crime of rape. If consent is obtained by the use of threats which convince the woman that it would be useless to resist, it is not necessary to prove actual violence. It has long been established by court decisions in England and America that deception, as when a married woman is deceived into believing that a man not her husband is her husband, does not constitute rape. Within the past 20 years statutes have been passed in England and many of the United States raising the age of consent for girls to 16 years. These laws have been of great service in protecting the young and promoting morality.

Raphael Santi, rā'fā-ël sän'tē (called by the Italians RAFFAELLE and RAFFAELLO, but generally in his own writings and in the signing of his pictures, RAPHAEL), Italian painter: b. Urbino in Umbria 28 March 1483; d. Rome 6 April 1520. The mountain town of Urbino was the capital of the ancient duchy of the same name, which came to an end in 1626. The castle or palace of the Duke is still a building of extreme interest; and there is evidence that during the lifetime of Frederigo and Guidobaldo—who reigned during the years of Raphael's youth—the palace was one of the most remarkable museums in Italy, being crowded with works of art both of antique and of Renaissance production.

The young Raphael was allowed to devote himself to art the more readily that his father (Giovanni) was himself a painter. It seems that the family had lost property; and there is much in the record concerning Raphael to indicate the existence in his character of traditions of elegant life and that kind of sympathy which comes from ancestral cultivation. At a very early age for a student of art he entered the workshop of Perugino; his possibly earlier studies with Timoteo Viti being of little consequence to his artistic growth. It is asserted that the young man went to Siena, where Pinturicchio was at work; but this is doubtful, and it is only important because there has been so much question about the true influence which at first determined or modified Raphael's career. It was as early as 1504 that he first went to Florence, and the artists who would then have influenced him the most were Leonardo da Vinci and Michelangelo; because while the earlier Florentines would be more immediately recognized by him as painters of the ancient and traditional manner, it is clear from his subsequent history that he was more quick than any other man would have been to adapt himself to the larger conditions of a new world of art. The first absolutely modern painting may be said to have come into existence with Leonardo da

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Vinci, although that great master allowed himself but little time to devote to executive work, and has left us almost nothing by which we can judge his full strength. As for Michelangelo (eight years Raphael's senior, and as precocious), his work must have revealed to Raphael the possibilities of magnificent design in which the human body is treated as the principal subject, without important assistance in the way of draperies, backgrounds, or even narrative subject, as a work of art.

The earliest painting which can be ascribed to Raphael with some certainty, is the Marriage or Betrothal of the Virgin (called 'Lo Sposalizio') at the Brera Gallery in Milan. This picture shows the Umbrian feeling, and has many resemblances to the full manner of Perugino, Raphael's master; but it is significant that no serious attempt has been made to dispute the ascription of it to Raphael himself, so great is the resemblance in the peculiar grace of its composition to the more mature works of the younger man. The most important record we have of his earliest stay in Florence, ending with his 25th year, is the Madonna with Saints in the National Gallery, commonly known as the 'Ansidei Madonna,' which, however, is thought to have been painted during a visit which he made to Perugia; and other Madonnas, such as that in the Pitti Palace, called the 'Madonna del Gran' Duca,' and the 'Madonna with the Goldfinch' in the Uffizi; as well as a picture in the Louvre Museum at Paris, called 'La Belle Jardinière.' This epoch, however, was one of constant production, and there are many smaller paintings, only less important, than those named above, which may with considerable certainty be given to this period, namely, the years of his life from 20 to 25. It was in 1508 that he went to Rome.

It does not appear that Raphael was sent for directly by the order of Pope Julius II., but he began work there almost immediately on his arrival, and indeed the first of the famous halls in the Vatican which are covered with his paintings was completed, nearly as we see it now, as early as 1511. This room, known as the Camera della Segnatura, or Chamber of the Signature, is a hall roofed with a solid masonry vault, having one large window turned nearly to the north and lighting the room fairly well on bright days. On the west wall is the famous painting known as the 'Disputa del Sacramento,' which should properly be called in English 'The Glory or the Triumph of Religion'; and opposite this to the east is the 'School of Athens.' Over the window is the Parnassus presided over by Apollo; and opposite the window is, in the lunette, the magnificent 'Jurisprudence'; while below this and on either side of the deep niche serving as the recess of a window now condemned, are paintings having to do with the Papal authority in earthly and spiritual things. Similar paintings adorn the dado beneath the great pictures, and the vault itself is covered with work by Raphael's own hand; in fact, lovers of Raphael's painting, considered by itself and without reference to its historical importance, have always found the Camera della Segnatura the most delightful place for the study of the master's individuality. There is every reason to suppose that the greater part of the work here is due to his own touch; the em-

ployment of assistants being much less probable here than in later works.

When this first series of important wall paintings was completed, Raphael was 28 years old, and he had only nine years to live. During those nine years were produced the paintings in the four large rooms in the Vatican adjoining the Camera della Segnatura, and also the decorative frescoes in the Farnesina Palace, the outdoor corridors and vaulted galleries fronting the Cortile di S. Damaso in the Vatican, which are known as the Loggie di Raffaele, and also a great number of easel pictures in oil, portraits, religious pictures sent as presents to the king of France and other foreign princes, and, toward the close of his life, two pictures of peculiar importance in his history, because they have always excited so much general admiration. These are the 'Madonna di San Sisto,' now in the royal collection at Dresden, and 'The Transfiguration,' left unfinished at his death, and now in the picture gallery of the Vatican. Raphael also made some designs, or at least undertook some superintendence as architect, especially in connection with the Church of Saint Peter, and as designer of several palazzi, or stately mansions, in and near Rome. The excavations going on among the ruins of Rome also excited his interest and took up much of his time. He was surrounded by assistant artists who worked with him or for him, under his general direction and also from his studies and under his immediate control. It is now impossible to discriminate between these different ways of work, except by means of the internal evidence of more or less characteristic handling in the painting. Thus it is generally agreed that the large frescoes of the battle at the Milvian bridge and the other paintings in the Stanza di Constantino are almost wholly by the hand of his assistants; while those in the Stanza dell' Incendio and in the Stanza dell' Eliodoro are, though not wholly by the hand of Raphael, his work as to their general designs, as to their composition both in mass and in color, and largely his own creation. The remarkable fact concerning these and the smaller paintings is that they all, except some of those in the Constantine series, belong to that well-known family or class of works which have become familiar to all the European world, as typical pictures by the artist who is generally accepted as the first of religious painters, while at the same time his name is used by artistic reformers as a symbol of the commencement of the decline of art.

His work shows little interest in realization of incident or of action; he is regardless of the impossibilities of the Apostles in long and voluminous robes, and of men in a fishing boat much too small for them — indifferent to the contradictions of the famous picture of 'The Conflagration in the Suburb' ('Incendio del Borgo'), where flames are seen flickering among marble columns and walls of cut stone without anything to feed them; and yet this lack of realism in his designs has never diminished his vast popularity, as the typical painter toward whose work everyone turns when there is mention of Christian religious painting. There is no better instance of the purely artistic quality obtaining full recognition in spite of the absence of those qualities which are generally



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considered more popular; the main reason for this is in the extraordinarily perfect composition in line and in mass, the figures filling the chosen oblong or the lunette or the circle in so many of his compositions, with absolutely faultless harmony, producing the desired result—a picture of entirely harmonious effect. As a colorist, he is not one of those painters to whom glow and splendor of hue is the important thing, who deem design in color supreme, as do Correggio and the great Venetians from the time of Vivarini to that of Tiepolo; but invested his noble linear compositions with a coloring wholly agreeable, never violent, always satisfactory to the student of sentiment in art, and to the lover of noble composition—those students being more numerous in the world than the lovers of color for its own sake.

Consult: Passavant, 'Rafaël und sein Vater'; Eugene Müntz, 'Raphaël, sa vie son Œuvre et son temps' (1881); 'Les Historiens et les Critiques de Raphaël' (1883); Crowe and Cavalcaselle, 'Raphael, his Life and Works' (1882); Bigot, 'Raphael and the Villa Farnesina' (1884).

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Raphael Ware. See MAJOLICA.

Raphall, Morris Jacob, American rabbi and author: b. Stockholm, Sweden, September 1798; d. New York 23 June 1868. In 1812 after receiving rabbinical education at Copenhagen, he went to England to study its language and literature, and after a continental tour spent three years at the University of Giessen, returning to England in 1825. In 1832 he lectured on post-Biblical history in London, in 1834 began a 'Hebrew Review and Magazine of Rabbinical Literature,' which he edited with much scholarship, was associated with D. A. De Sola in a translation of 18 treatises of the 'Mishna,' and with Messrs. De Sola and J. L. Lindenthal in a commentary on Genesis. In 1841 he was elected rabbi of the Birmingham Synagogue and in 1849 was called to the Congregation B'nai Jeshurun of New York, where he remained until his death. In 1855 he published his 'Post-Biblical History of the Jews.' In addition he wrote some learned pamphlets and was a contributor to 'The Jewish Messenger.' His defense of slavery from the biblical standpoint ('The Bible View of Slavery') aroused much controversy in the early days of the Civil War.

Rapha'nia, another name for the disease called ergotism (q.v.).

Raphia, a genus of low African palms with oval, gigantic pinnate leaves, and fruit spikes often weighing from 200 to 300 pounds. See PALMS.

Rapid-fire Guns. See ORDNANCE.

Ra'pier, a sword-like weapon, light, highly tempered, edgeless and finely pointed. It is about three feet in length, and was long a favorite weapon for dueling.

Rapin de Thoyras, rä-pän de toi-rä, Paul, French historian: b. Castres, Languedoc, 1661; d. Wesel, Duchy of Cleves, 1725. He studied at the Protestant Academy of Saumur, and was admitted an advocate in 1679. The revocation of the Edict of Nantes, however, drove him to England in 1686, and subsequently to Holland, where he entered a company of French cadets.

In 1689 he followed the Prince of Orange and distinguished himself at the battle of the Boyne. In 1707 he settled at Wesel and devoted himself to historical composition. His great work, 'L'Histoire d'Angleterre' (1724), was very animated, but impartial, and contains much solid information. The style is clear, the facts are methodically arranged, and he is always careful to cite his authorities. It embraces the period from the invasion of the Romans to the accession of William and Mary, but continuations by other pens were afterward added.

Rapp, rāp (Johann) George, German secretary, founder of the communistic society called Harmonites: b. Iptingen, Württemberg, 1 Nov. 1757; d. Economy, Pa., 7 Aug. 1847. He studied in the village school, became a linen weaver, and even before 1783, when he married, had religious doubts and visions, and dated his "complete surrender" from the year 1782. His peculiar religious ideas were so tinged with political socialism that his followers were persecuted by the German government; and in 1803 he emigrated. In the next year he founded at Harmony, near Pittsburg, a communistic colony, where work, unity, equality, and celibacy were the rule. A new colony, called New Harmony, was founded on the Wabash in Posey County, Ind., in 1815 and was sold to Robert Owen (q.v.) in 1824 when Rapp and his followers returned to Pennsylvania, founding on the Ohio River the town of Economy (q.v.). Consult: Nordhoff, 'Communistic Societies of the United States' (1875); Knortz, 'Die Christlich-kommunistische Kolonie der Rappisten' (1892).

Rapp, Jean, COUNT OF, French general: b. Colmar, Alsace, 27 April 1772; d. near Lorrach, Baden, 8 Nov. 1821. In 1788 he entered the military service, accompanied Desaix during the campaigns in Germany and Egypt, and after Desaix had fallen at Marengo, became aide to Bonaparte. On the breaking out of the war against Austria, in 1805, he accompanied Napoleon, and after the battle of Austerlitz, where he threw the Russian guards into confusion by a bold attack with his cavalry, he was made brigadier-general. For distinguished service done in 1809 he was created a count of the empire, and in 1811 received the cross of grand officer of the Legion of Honor. He was seven years commander of Dantzic, which he defended after the retreat of the French army from Russia, till 1814, during a severe siege of nearly a year, in which he displayed great talent and brilliant courage, and not till all means of defense were exhausted, and he was compelled by famine, did he capitulate. Returning to France in 1814, he was received with distinction by Louis XVIII., and in March 1815, was sent against Napoleon. But when the defection of the whole army rendered all resistance impossible, Rapp also went over to Napoleon, who made him commander of the army of the Rhine. When Louis XVIII. returned a second time to Paris Rapp was pardoned, and retained the command of the 5th division, granted him by Napoleon, till the army was disbanded. After his death appeared the interesting 'Mémoires du General Rapp, écrits par lui-même' (1823). Consult: Spach, 'Le Général Rapp' (1856).

Rapp, Wilhelm, German American journalist: b. Germany 14 July 1828; d. 1 March

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1907. He was an active participant in the German revolutionary movement of 1848, and in 1852 emigrated to the United States where he took up journalism as his occupation. He was the successful editor of the 'Turnzeitung' of Philadelphia and Cincinnati, the 'Baltimore Waechter' (1857-61), (1866-72), and the 'Illinois Staats Zeitung' of Chicago (1861-6), and again from 1891. He wrote 'Recollections of the German Fatherland by a German-American.'

Rappahannock, rāp-a-hān'ók, a river of Virginia, formed by several small streams which have their rise in the Blue Ridge. It flows east-southeast into the Chesapeake Bay, which it enters about 25 miles below the Potomac. It is about 250 miles long and is navigable over 90 miles from its mouth. The upper part of its course is through a mountainous country, where it is a swiftly flowing stream with many rapids and low falls. At Fredericksburg (q.v.) is a fall which furnishes extensive water power. From Fredericksburg the river becomes a tidal stream, and the broad, long estuary which enters the bay is navigable for the largest steamers. The name of the Rappahannock is associated with many of the events of the Civil War.

Rappahannock Station, Battle of. In the fore part of October 1863 Gen. Lee maneuvered the Army of the Potomac, under Gen. Meade, from the Rappahannock River back to Centreville. Meade resumed the offensive 19 October, and in several encounters pressed Lee back to the Rappahannock, Lee crossing to the south side of the river and disposing his army on both sides of the Orange and Alexandria Railroad, Ewell's corps on the right and A. P. Hill's on the left, with cavalry on both flanks. A part of Ewell's corps was left on the north side of the river at Rappahannock Station, in an intrenched position covering the pontoon-bridge, the railroad bridge having been destroyed. The position was first held by Gen. Hays' brigade and four guns, to which was subsequently added Gen. Hoke's brigade, under Col. A. C. Goodwin. The whole force numbered about 2,000 men. Lee had destroyed the railroad from Bristoe Station to the Rappahannock, a distance of more than 20 miles, and this had to be rebuilt before Meade could follow to the river. It was completed as far as Warrenton Junction on 2 November; supplies were brought up; and on the morning of the 7th Meade advanced to cross the Rappahannock. Gen. French, with the left wing of the army, moved upon Kelly's Ford, five miles below Rappahannock Station, and forced a passage of the river (see KELLY'S FORD, ENGAGEMENTS AT), while the Fifth and Sixth corps, under command of Gen. Sedgwick, moved along the line of the railroad, forming line about midday within one and a half miles of Rappahannock Station, the right of the Fifth corps and the left of the Sixth on the railroad. Skirmishers were thrown forward and the Confederate position reconnoitered, and as soon as it could be ascertained a plan of attack was formed. The works to be carried consisted of two redoubts, connected by a chain of rifle-pits, and a further line of rifle-pits ran from the left redoubt to the river and some distance along it. The Fifth corps was to gain the river bank on the left, and the Sixth on the right, in order to establish artillery on a range

of high ground in front of the works and drive the men from them. The river bank was gained both on the right and left, artillery put in position, and the works shelled, but at dusk no impression had been made, the Confederate guns had not been silenced, nor had the infantry been driven from the works. Gen. Russell, temporarily commanding Wright's division of the Sixth corps, said that he could carry the works by assault, and he was ordered to do it. It was now after dusk; artillery fire was kept up; Russell led parts of Ellmaker's and Upton's brigades, in all 2,117 men and, under a heavy fire of musketry and canister, went over the works in a very few minutes, capturing 1,303 officers and men, the four guns, 1,225 stands of arms, and seven battle-flags. A part of the Fifth corps on the left joined in the assault. Gen. Wright says in his report that this was the first case during the war of an intrenched position being carried on the first assault, and one of Gen. Lee's biographers writes that it was the saddest chapter in the history of the Army of Northern Virginia. Gen. Hays, with nearly 300 of his men and about 130 of Hoke's, escaped. The Union loss was 413 killed and wounded, and six missing. Gen. Lee reports his loss as 6 killed, 39 wounded, and 1,629 captured or missing, some of the missing being probably killed or wounded. Lee now abandoned his design of attacking Gen. French, who had crossed at Kelly's Ford, burned the end of the pontoon-bridge remaining in his possession, the north end of it having been captured by Russell, and fell back during the night to Mountain Run. Gen. Meade crossed the remainder of his army over the Rappahannock on the 8th and moved to Brandy Station, and Lee crossed to the south side of the Rapidan. Consult: 'Official Records,' Vol. XXVI.; Humphreys, 'From Gettysburg to the Rapidan'; the Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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Rap'pists. See HARMONISTS.

Raptores, an old name in classification, variously limited, for the predatory birds. See BIRDS OF PREY.

Raratonga, rā-rā-tōng'gā, or Rarotonga, an island in the South Pacific Ocean, belonging to the group of Cook Islands (q.v.).

Rarey, John S., American horse tamer: b. Franklin County, Ohio, 1828; d. Cleveland, Ohio, 4 Oct. 1866. In early life he showed a marked fondness for horses and skill in their management, which he later developed by study and close association with them. In 1856 he went to Texas to further his knowledge and upon his return to Ohio engaged in startling exhibitions of his skill. In training or taming the horse his methods were always prompted by a humane spirit, the use of the lash not being resorted to unless in extreme cases. In 1861 he visited England, Russia and other European countries, where his mastery over the wildest steeds amazed and delighted his vast audiences.

Rar'itan, a river in New Jersey, the headwaters of which are in the northern part of the State. It enters Lower New York Bay through Raritan Bay. The latter is really the broad mouth of the Raritan River. The river is navigable to Brunswick Landing, about two miles above New Brunswick.

RASCAL LEAF-CRUMPLER — RASKOLNIKS

Rascal Leaf-crumpler, the leaf-folding caterpillar of a phytoid moth injurious to many American fruit-trees, as the apple, cherry, plum (qq.v.), etc.

Rash, an eruption on the skin. The commonest rashes are those of the specific fevers, the crimson rash of measles, the scarlet rash of scarlet fever, the rose-spots of typhoid fever, etc. But there are also numerous eruptions due to disordered states of the body, and apart altogether from any infectious disease; such are nettle-rash and the like.

Rashi, *rā'shē*, properly **Rabbi Salomon-Ben-Isaak**, sometimes erroneously called **Jarchi**, the most famous of French rabbins: b. Troyes about 1040; d. 1105. Entering the Jewish school in Worms he made astonishing progress in ancient languages, philosophy, medicine, and astronomy. His skill in explaining the Holy Scriptures and the Talmud was so remarkable that his contemporaries honored him with the titles of interpreter of the law and prince of interpreters. To satisfy his longings after knowledge he undertook an extensive tour through Italy, Greece, Palestine, Egypt, Persia, and Germany, where he was particular in visiting the towns which possessed learned Jewish schools. The literary treasures thus collected he introduced into his writings, which were received at the time with the greatest enthusiasm, and are still held in high estimation. His most famous work is a commentary on the Pentateuch. He also wrote commentaries on the prophets, the Talmud, and various treatises on miscellaneous subjects. Consult: Zunz, 'Zeitschrift für die Wissenschaft des Judenthums' (1822).

Rask, *räsk*, **Rasmus Christian**, Danish scholar: b. Brendekilde, island of Funen, 22 Nov. 1787; d. Copenhagen 14 Nov. 1832. He studied at the University of Copenhagen, undertook a journey to Sweden and Russia, to increase his acquaintance with the northern languages; and in 1808, after a two years' stay in Iceland became assistant in the academical library of Copenhagen. His fame as a linguist is founded upon such works as 'An Introduction to the Knowledge of the Icelandic or Old Norse Tongue' (1811); an edition of Biörnönis Haldorsen's 'Icelandic Dictionary' (1817); 'Instruction in the Anglo-Saxon Tongue'; and 'Researches as to the Origin of the Old Norse or Icelandic.' In 1822 he was appointed professor of literary history at the University of Copenhagen, and subsequently professor of Oriental languages and librarian to the university. During this period he published, among other works, a Spanish Grammar; 'Instruction in the Friesland Tongue'; 'On the Antiquity and Genuineness of the Zendavesta.'

Raskol'niks, or **Rascolnicians**, the name applied collectively to all the dissenters from the orthodox church of Russia, the Greek-Eastern Church. The schism, or *raskol*, was affected at two different times principally; first during the 17th century upon the occasion of the revision of the Testaments by Patriarch Nikou (1652-8) at Moscow; and upon the further revision and the usurpation of secular powers by Peter the Great (1689-1725). On both these occasions great bodies of Raskolniks, refusing to comply with the reforms instituted, left the

church and set up their own religious communities. The general characteristic of all the Raskolniks is conservatism. Differing from the English dissenters who have usually instituted some reform in the creed or the ritual of the body from which they seceded, the Raskolniks secede because they wish to cling to their old customs and beliefs and do not agree to innovations in the orthodox church.

The Raskolniks are of two great classes, each of which is subdivided with endless schisms, and dissenting sects, more or less antagonistic to each other. The Popovtzi, those who have priests, *pops*, in Russian; and the Bezpopovtzi, or those who have no priests. Of these the Bezpopovtzi are the more numerous, the most aggressive and the least conservative.

The Popovtzi have not changed from the beliefs of their old church. They are, for the most, inoffensive and tolerant, and have lately been treated by the state with less severity than before. Under Alexander II. they were allowed to reopen their churches and to build new ones. A certain measure of civic rights was also granted them, together with liberty of religious services. This branch of the Popovtzi, known as the Edinovertzi, have a bishop, who resides at Moscow. Another and much smaller class denounce the Czar and the Established Church and for that reason are treated as dangerous fanatics.

The Bezpopovtzi are much more inimical to the State and the Church. They believe that the present age is one of the anti-Christ, that the authorities to-day, both temporal and spiritual, are his servants and that therefore it would be sin to recognize their authority. They have no priests among themselves, as they believe that every Christian is a priest, in support of which they quote Rev. i. 6, and that churches are unnecessary, since a Christian's body is a temple, based upon 1 Cor. iii. 16. Some of the principal sects of the Bezpopovtzi are: Doukhobors (q.v.), who in some respects resemble the early Quakers; the Vozdykhantzi, who hold that the world at present is under the reign of the Holy Ghost, whom they worship by prayers and sighing; the Philipppines, who observe only two sacraments, the Lord's Supper and Baptism; the Stranniki, who believe the promises of the Lord concerning the Church are already fulfilled and that we are living in the first era of the resurrection; the Molokane and the Obschie (the latter being communists), who reject all external rites; and the anarchistic Khlisti and Skoptzi. These latter two sects are the most feared and hated by the Russian Church and State. The Khlisti are ascetics and practise many fanatical rites under the direction of their prophets and prophetesses, one being that of bodily scourge. The Skoptzi carry the beliefs of the Khlisti to an even greater extreme, mutilating their bodies in horrible manner in the frenzy of their rites. The Khlisti and Skoptzi are treated as criminals and transported to Siberia by the government; other sects of the Bezpopovtzi are denied many of the civil rights enjoyed by the Popovtzi, are closely watched by the police and are much feared by the government.

The Raskolniks, as a whole, are not allowed to worship in public except in their own chapels and churches, which latter must be of distinctly

different appearance from the Eastern-Greek churches; they are not allowed to propagate their beliefs, to open their convents, or to take any part in public processions, either private or official. The number of Raskolniks in Russia has been variously estimated as from five to fifteen millions. According to one writer in 1890 they were thus accounted: the Popovtzi, three millions; the Spiritual Christians, two millions; the Khlisti and Skoptzi seventy-five thousand; other sects of Bezpopovtzi, nine millions. (See RUSSIAN RELIGIONS.) Consult: Gardner, 'Faiths of the World'; Mouravieff, 'History of the Church of Russia' (London, 1842); and any encyclopædia of religious beliefs.

Raso'res, an obsolete, artificial group of birds, the "scratchers," represented by such forms as the fowls, partridges, grouse, pigeons, etc., which were long ago assigned to various natural orders and families.

Raspail, räs-pä-ë, **François Vincent**, French politician and scientist: b. Carpentras 29 Jan. 1794; d. Arcueil 7 Jan. 1878. He went in 1816 to Paris, where he took part in the July revolution of 1830, and later established a journal, 'Le Réformateur,' which in 1834 was suppressed by the government, while in 1835 its editor was condemned to a six months' imprisonment. On 24 Feb. 1848, at the head of a mob, he penetrated to the council chamber of the provisional government, which he compelled forthwith to proclaim the republic. He then founded 'L'Ami du Peuple,' later called 'Démocratie Pacifique,' in which he proclaimed Jacobin principles. On 15 May he was a leader of the invaders of the Palais Bourbon and the hall of the national assembly; for this he was condemned to six years in prison, but in 1855 the sentence was commuted to banishment. He lived in Brussels, but returned to France under the amnesty of 1859, was elected to the Corps Législatif in 1869, retired to private life during the Commune, and from 1876 was a member of the Chamber of Deputies. Among his works were: 'Annales des Sciences d'Observation' (1829-30); 'Recherches Chimiques et Physiques sur le Développement des Tissus Végétaux' (1827); 'Système Nouveau de Physiologie Végétale et de Botanique' (1836); 'Histoire Naturelle des Ammonites' (1842); 'Nouvelles Etudes Scientifiques et Philologiques' (1865); 'Réformes Sociales' (1872).

Raspberry, a general name for those shrubs of the genus *Rubus*, whose fruits separate from the receptacle upon attaining maturity. They are natives of the north temperate zone and are especially numerous in Europe and America. They are characterized by their perennial underground parts, usually biennial spiny stems which bear fruit the second season and then die. Several species are valued for ornamental purposes but the three following are the most important because of their edible fruits, for which the plants are widely cultivated especially in the United States and Canada. The European raspberry (*R. idæus*), which has been cultivated in Europe for several centuries, was among the earliest European fruits introduced into America, but it has not made an equal headway with the next species because it has a very extended period of ripening, and is more adapted to the amateur than to the com-

mercial berry-grower. Its fruits, either red or yellow, are of the best quality, but the plants are considered somewhat tender in northern climates. The American red raspberry (*R. strigosus*) resembles the preceding species in habit and color of fruit, but is rather inferior in quality. This defect, however, is offset by its great productiveness, "cropping" qualities, hardiness and ready adaptability to many conditions. Having been in cultivation for only about half a century, its quick development to the rank of a leading small-fruit augurs still greater possibilities. The black raspberry or blackcap (*R. occidentalis*) is the most important species of its genus, since it is hardy, productive, adaptable to many soils and conditions, and its fruits, being firm, are useful for shipping considerable distances or for evaporating as well as for canning and eating fresh. It was introduced into cultivation in 1832, since when several hundred varieties have been offered for sale.

The red raspberries are propagated by means of suckers, or root-cuttings. The former may appear at any time throughout the growing season; the latter may be made by thrusting a spade deeply into the ground around well established plants and thus severing the roots, each piece of which will produce a new plant. With new or scarce varieties the plants are often dug up, the roots cut in small pieces and rooted under glass. In the field the plants are usually set not less than 5 by 5 feet or 4 by 6 feet apart. In the former case cultivation is given each way; in the latter only one way after the plants are two years old, the rows becoming more or less continuous from the growth of suckers. The former is generally preferred.

The black raspberry does not produce suckers, except at the crown, but the tips of the canes bend over until their tips reach the ground and become covered and develop roots. Other buds near the end may develop short stems which also become rooted. These "tips" are severed for planting, sometimes in autumn but usually in spring, and are set somewhat farther apart than the red varieties. There is a hybrid group of raspberries which propagate by both tips and suckers or root cuttings, usually by the latter. They are supposed to be derived from the black and the American red species, but since they are common in the wild state and are fairly stable, they are often called *R. neglectus*. Several varieties have been widely cultivated. Their fruit ranges from purple, through reds to yellow.

Raspberries succeed best upon deep, moist, but well drained loamy soils; the blacks upon the heavier and the reds upon the lighter. The more retentive of moisture the soil is the better, since the fruit ripens at a time when water is often scarce. Hence the addition of humus is often desirable. It may be most easily obtained in the form of stable manure and green manures, such as clover grown at least one year before planting. The ground should be plowed as deeply as possible without turning up the subsoil, and after harrowing, the plants set. Clean cultivation both ways is usually practised until midsummer when a cover crop of crimson clover or some shallower rooting plant is sown to be turned under the following spring. Sometimes, however, other crops, such as potatoes, carrots,

RASPBERRY VINEGAR—RASSIEUR

beets, etc., which are not tall, are grown between the rows for one or perhaps two years. Wood ashes, muriate of potash, superphosphates, and ground bone are favorite sources of potash and phosphoric acid. With adequate tillage during the summer, spring plowing may be avoided.

The pruning of the red varieties consists in pinching back the shoots during the first season, allowing only about five canes to grow in each stool in after years, avoiding the pinching of shoots unless the soil is very strong and the growth rampant, and cutting out the old canes as soon as they have fruited. The pruning of the blackcaps consists in pinching off the tips as soon as they have reached a height of about 21 inches to make the canes stocky and self-supporting, and shortening in the branches to about 18 inches the following spring. This latter amounts to thinning and should be carefully done.

For market the fruit should never be picked until after the dew has dried and should be shipped to market in small packages. Red raspberries are usually marketed in pint baskets. Black raspberries, specially for canning, are often gathered by jarring the ripe fruits into aprons with boxes attached, the fruit being passed through a fanning mill to blow away the leaves, etc. Generally, however, the picking is done by hand with red raspberries and with both kinds for the best markets.

Among the numerous insects which feed upon the raspberry are two species of cane-boring beetles, *Agilus ruficollis* and *Oberea bimaculata*; wilting of the canes is usually the first indication of their presence, and cutting the injured ones is the only remedy recommended. The snowy tree-cricket (*Ecanthus niveus*, etc.) often lays its eggs in the stems, but is considered to be a beneficial insect otherwise, since its food consists largely of plant-lice. Several caterpillars and other foliage-chewing insects, such as the raspberry saw-fly (*Selandria rubi*), occasionally prove troublesome, and some of the stink-bugs reveal their presence by their disagreeable flavor when inadvertently eaten. General remedies have been recommended for these insects. (See INSECTICIDE.) Several so-called plant diseases have been reported upon the raspberry. The orange rust has never been successfully combated except by digging out and burning plants attacked by it; and anthracnose has been held in check by spraying. (See FUNGICIDE.)

Consult: Bailey, 'Cyclopedia of American Horticulture' (New York, 1900-2); Card, 'Bush-Fruits' (New York, 1899); Saunders, 'Insects Injurious to Fruits' (Philadelphia, 1889); Smith, 'Economic Entomology' (Philadelphia, 1896;) and numerous bulletins of Agricultural Experiment Stations.

M. G. KAINS,
Crop Expert.

Raspberry Vinegar, a refreshing summer beverage and cooling drink for invalids, composed of raspberry juice, vinegar, and sugar.

Raspe, rās'pé, Rudolph Eric, German mineralogist and author: b. Hanover 1737; d. Muckross, Donegal, Ireland, 1794. In 1767 he was made professor in the Collegium Carolinum of Cassel, and curator of the Landgrave's museum of coins and antiquities. He published

at this time papers on mineralogy and geology. In 1775 he went to England, where he was variously employed, generally as a mining expert. He published in 1785 'Baron Münchhausen's Narrative of his Marvelous Travels and Campaigns in Russia,' founded in part on the hunting stories of one Baron von Münchhausen, of Hanover. His work appears as chapters ii.-vi. of the later Münchhausen. See MÜNCHHAUSEN.

Rassam, rās-sām', Hormuzd, Turkish archaeologist: b. Mosul, Asiatic Turkey, 1826. Having formed the acquaintance of Layard (q.v.) in 1845 when the latter was beginning his explorations of the remains of Nineveh, Rassam accompanied him on his return to London and entered Oxford University, after which he went with Layard on several archaeological expeditions. In 1851 Rassam, upon commission from the British Museum, collected for that institution a number of specimens of Assyrian art, particularly a series of sculptures representing the lion chase. In 1864 the British government despatched him on a mission to Abyssinia to secure from King Theodore the release of their consul, Mr. Cameron, and others held prisoners; but he was himself taken prisoner and held until the defeat of Theodore's army by Sir R. Napier in 1868. After 1876 he resumed his collections for the British Museum, the most notable of which were the bronze gates of Balawat, dating from Shalmanezzer II., 858-824 B.C., and the "Abu-Habba tablet," from the temple of the sun-god in Sippar, recording the restoration of the temple by Nabu-apal-iddin. The British Museum was also enriched by his discovery of 5,000 tablets representing, probably, the library of an ancient Babylonish king. Rassam published a 'Narrative of the British Mission to Theodore' (1869); 'Asshur and the Land of Nimrod' (1897).

Rasse, rās, a small arboreal civet (*Viverricula malaccensis*), which is widely distributed in southeastern Asia and the Malayan islands; and long ago became naturalized in Madagascar. It is slender, agile in tree-climbing, has no erectile mane, and lives in holes in rocky and brushy districts. In confinement it is easily tamed and feeds on small animals, which it catches with cat-like dexterity. Hence it is often kept in houses in the East as a rat, and also for the sake of its civet, which is artificially removed from the glands. It is a handsome little animal, spotted with blackish on a gray ground, and with a long black-ringed tail. Consult: Blanford, Jerdon, Tennent, and other authorities on Oriental zoology.

Rasselas, rās'ē-lās, a philosophical romance by Dr. Samuel Johnson, published in 1759. Though little read at present it was in the 18th century the most popular of its author's works and was translated into many modern languages. It professes to relate the story of Rasselas, prince of Abyssinia, who with his brothers and sisters inhabits a Happy Valley secluded from the outside world.

Rassieur, rās'sē-ēr, Leo, American lawyer: b. Waden, Prussia, 19 April 1844. He was graduated at the Saint Louis Central High School in 1860. During the Civil War he volunteered as a private, and in 1865 was raised to the rank of major. In 1867 he was admit-

RASTATT — RATIFICATION

ted to the Saint Louis bar and after holding office in the public schools was elected judge of the Probate Court (1899). In 1900 he was elected commander-in-chief of the Grand Army of the Republic.

Rastatt, räs'tät, or **Rastadt**, a town of Baden, Germany, on the river Murg, about 4 miles from the Rhine and about 15 miles southwest of Karlsruhe. It was formerly a fortress of the first rank, but in 1802 the fortifications were dismantled. The town has manufactures of lace, tobacco and cigars. Population nearly 16,000. Rastatt was the scene of two diplomatic congresses in the 18th century. The first congress of Rastatt met in 1713 to arrange terms of peace between the emperor and France, then still engaged in the war of the Spanish Succession. Peace was concluded 7 March 1714. In accordance with the terms of the treaty France gave up possession of the towns of Kehl, Freiburg and Breisach, and the electors of Cologne and Bavaria were reinstated in power. The terms of the treaty of Utrecht (q.v.) were ratified. The second congress of Rastatt met in 1797 for the purpose of terminating hostilities between France and the Empire. After negotiations had been prolonged for more than a year, war broke out again between France and the allies and the congress suspended its sessions (April 1799). As the French representatives, Roberjot, Bonnier and Debry left the city on the evening of 28 April, they were set upon by a company of hussars wearing the Austrian uniform and the first two were murdered. Many attempts have been made to fix the responsibility for the deed. Some have ascribed the crime to the Austrian government which was desirous of obtaining certain papers in the possession of the ambassadors; others maintain that the murderers were French émigrés, while others still assert that the act was instigated by Napoleon and other leaders of the war party in France for the purpose of exasperating the French people against Austria.

Rat, any of several large rodents of the mouse family (see MOUSE), especially two species of "house-rats" now habituated to civilization in all parts of the world. The black rat (*Mus rattus*) is of light and slender build, about seven inches in length, usually of a bluish black color, but sometimes grayish, and has quite large thin ears. The brown rat (*M. decumanus*) or Norway rat, as it is often inappropriately styled, is much heavier and larger, with short rounded ears and a dull brown color. Both species are believed to be natives of China, but the black rat was abundant in Europe at least as early as the 13th century. The brown rat migrated from Western China, entering Russia in great numbers in 1727, and from there quickly spreading over Europe, which was fully occupied by it by the middle of the 18th century. By its greater fecundity and ferocity it quickly overcame the black rat, which it has now replaced in most parts. It infested ships and by this means has been carried to all parts of the world. Its wonderful capacity for increase (from 20 to 50 annually), its boldness, tough, elastic constitution and adaptable nature, make it everywhere dominant, and its omnivorous habits, voracity and destructiveness frequently lead it to become a source of great

annoyance, loss and disease about human habitations. The ferocity of this species when brought to bay is well known; and when driven by hunger it is so ravenous that neglected babies have been known to be killed and eaten by them, and a few cases are recorded where even able-bodied men have suffered a like fate when attacked by hordes of rats. They are also agents in the spread of disease, particularly bubonic plague and trichinosis. Against their many faults may be set the solitary virtue that they serve a useful purpose as scavengers in the city sewers, etc. The albino and black and white pied rats sold for pets by bird dealers are derived from the black rat, which has a far milder disposition.

Rat-kangaroo. See KANGAROO.

Rat Portage, Canada, town and port of entry, Ontario, at the outlet of the Lake of the Woods, and on the Canadian Pacific Railway, 130 miles by rail east of Winnipeg. It is the chief town of the Rainy River District, and the distributing centre for the neighboring gold mines. The Winnipeg River with a fall of 16 feet from the lake, furnishes inexhaustible water power for sawmills, flour-mills, and other industrial establishments. The neighboring lake fisheries, especially of sturgeon, are valuable. Pop. about 6,000.

Rat-tail, one of the pelagic, cod-like fishes of the genus *Macrourus*, specifically *Macrourus bairdi* of the coast-waters of the eastern United States.

Ra'ta, any of several New Zealand trees of an Australasian group of the myrtle family which includes the local ironwoods. Foremost among them is *Metrosideros robusta*, a tall strong tree, of very hard wood, used by the natives for making their war-clubs, and by the colonists in cabinet-work and in ship-building. Another species (*M. florida*) is a huge climber. These trees have very showy flowers, usually red, and characterized by many tall erect stamens; and several species of the genus are cultivated as ornamental shrubs, and have been acclimatized in other parts of the world. One (*M. tormentosa*) is known in New Zealand as "fire-tree."

Ratafia, răt-a-fě'a, a French cordial flavored with fruits; a general name for any liquor flavored with fruit syrups.

Rat'any, or **Rhatany**. See RATTANY.

Ra'tel, a South African badger (*Mellivora capensis*), rather larger than the common European or American badger, which lives in burrows in open districts. It differs from the Indian honey-badger (q.v.) mainly in the presence of a distinct white line along its sides, from the nose to the hocks, separating the black underparts from the blanket-like gray of the back.

Rath'bone Sisters, Order of. See ORDERS, RELIGIOUS.

Ratichius, ră-tik'ĩ-ūs. See RATKE, WOLF-GANG.

Ratifica'tion, in law, the confirmation, sanction or approval given by a person who has arrived at his majority to acts done by him during his minority. It has the effect of giving validity to such acts as would be otherwise voidable. "An act performed by one for another,

RATIO — RATIONALISM

is adopted as his own act when by him ratified. Ratifications are either express or implied. The former are made in express and direct terms of assent; the latter are such as the law permits for the acts of the principals.⁹

Ratio (from the Latin *ratio*, meaning reckoning, calculation), in mathematics, the measure of the relation which one quantity bears to another of the same kind; that is, the number of times that one quantity contains another regarded as a standard. This is found by dividing the one by the other. The quotient or ratio thus obtained is the proper measure of the relation of the two quantities. Some mathematicians define the ratio of one quantity to another as the quotient of the first quantity divided by the second, and others define it as the quotient of the second quantity divided by the first. The operation of finding a ratio is purely numerical, and the resulting ratio is consequently an abstract number. Ratios are known as *prime* or *ultimate*, according as the ratio of the variable quantities is receding from or approaching to the ratio of the constant quantities. Proportion is the relation of equality subsisting between two ratios. See MATHEMATICS; PROPORTION.

Ration, in the army and navy, is the allowance of provisions given to each officer, non-commissioned officer, soldier, and sailor. In the American army the ordinary ration is commonly supplemented by additional articles bought with what is known as "the company fund," money derived from certain allowances made to the soldiers. The American troops and sailors are better fed than any in the world, whether in camp or war.

Rationalism, in its more general signification, denotes a tendency or attitude of thought, either on the part of an individual or an age, to demand that prevailing beliefs, customs, and institutions shall be subjected to critical examination, and be required to justify themselves before the court of reason. In its more specific sense, the term refers to the doctrines of a particular school of philosophical thinkers, which flourished mainly in France and Germany during the 17th and 18th centuries, and which regarded reason as the only source of certain knowledge, and the only test of truth.

In the general and more popular use of the term, rationalism is equivalent to a demand for a reasonable explanation in scientific terms. The rise of rationalism is thus in many respects identical with the development of the scientific spirit of inquiry. As such, it is opposed to mysticism and supernaturalism. Lecky, in his 'History of the Rise and Influence of Rationalism in Europe,' explains the word as follows: "By the spirit of rationalism, I understand not any class of definite doctrines or criticisms, but rather a certain cast of thought, or bias of reasoning, which has during the last three centuries gained a marked ascendancy in Europe. . . . At present, it will be sufficient to say, that it leads men on all occasions to subordinate dogmatic theology to the dictates of reason and of conscience, and, as a necessary consequence, greatly to restrict its influence upon life. It predisposes men, in history, to attribute all kinds of phenomena to natural rather than miraculous causes; in theology, to esteem succeeding systems the expressions of the wants

and aspirations of that religious sentiment which is planted in all men; and, in ethics, to regard as duties only those which conscience reveals to be such.⁹ Between the claims of revealed religion and the spirit of rationalism the conflict has been especially sharp and long-continued. This opposition shows itself even before the birth of Christianity in almost all of the older religions. In Greece, for example, where religion was only to a very slight extent embodied in dogmas, the philosophers were nevertheless frequently charged with atheism, or with perverting and destroying the national religion through their rationalistic teachings. With the establishment of the Christian Church, the doctrines of religion were explicitly declared to be above reason, and to rest upon a higher authority than human reason could afford. Nevertheless, from time to time there arose thinkers within the Church itself who strove to reduce the theological doctrines to a rationalistic basis, interpreting them in such a way as to minimize or destroy the supernaturalistic elements which they contained. Of these mediæval rationalists Abelard (q.v.), 1079-1142, is perhaps the most famous. It was not until the 18th century, however, that rationalism became strong enough and bold enough to make open war upon the prevailing theological beliefs and doctrines. This century was called the age of enlightenment, and in it the demand arose on all sides that everything should be explained in terms of the clear and distinct ideas of reason, that mysteries and superstitions should be abolished, that the authority of church and state should be limited and subordinated to the principles of reason and the interest of the individual members of society. The Deistic movement in England is especially noteworthy as maintaining the right of individual free thought in matters of religion, and as attacking the abuses and absurdities in the existing theological creeds. Lord Herbert of Cherbury and John Locke may be regarded as forerunners of English Deism (q.v.). The best known representatives of the movement are John Toland (1670-1729), Anthony Collins (1676-1729), Matthew Tindal (1657-1733), Thomas Chubb (1679-1747), and Thomas Morgan. The influence of this movement was felt throughout Europe. In Voltaire it found a spokesman of extraordinary literary power who had also the courage to carry its principles to its logical conclusions.

The spirit of rationalism, in so far as it represents the claims of free scientific inquiry, may be said to have already won its triumph. This triumph too, it must be admitted, was largely the result of the enthusiastic zeal of the apostles of the enlightenment. Nevertheless, the spirit of modern inquiry has been profoundly modified in many respects during the 19th century. In the first place, it has lost the narrowness and hardness that it necessarily exhibited so long as a large share of its strength was expended in negative criticism and in making war upon prevailing creeds and institutions. In addition, it has been transformed by the historical and evolutionary conceptions that have become dominant in every field of inquiry, leading men's thoughts, to problems of genesis and origin, and so to understand and sympathize with much that appeared absurd and unmeaning to the older rationalists. The 18th century

RATIONALISTS — RATITÆ

rationalists regarded the world as static; they looked at each thing as it actually stood before them in their own day, and judged it by the unflinching standard that each individual was supposed to possess in the clear and distinct ideas of his own individual reason. The historical point of view has brought with it a broader conception of reason and what is rational: it has taught us that it is only in the light of its origin and function that a thing can properly be judged, and that, accordingly, there may be a truer rationality in historical creeds, beliefs, and institutions than in the self-confidence of the individual of clear and distinct ideas who ventures to criticize what he does not understand.

The philosophical doctrine known as rationalism owes its origin to Descartes (1596-1650), and has its home mainly in France and Germany, while empiricism (q.v.), the theory to which it was directly opposed, flourished mainly in England. The rationalistic school take mathematical demonstration as the perfect type of knowledge, and seek to model their procedure in all fields of inquiry on what they assumed to be its method. From the chaotic and contradictory material supplied by sense-perception they believed that real knowledge, science, could not be attained. Mathematics, however, reaches its results in independence of such a source. It begins with fundamental principles and conceptions which are self-evident, and proceeds by means of logical analysis and reasoning to show what further results are necessarily involved and implied in the starting-point. Now, the rationalistic thinkers maintain that what has been achieved in this particular science may be carried out universally by the application of the same method. That is, the true method of knowledge consists in first discovering by analysis the fundamental truths that lie at the basis of all thinking. These truths are not derived from experience, but, like the mathematical axioms and first principles, are native to the mind, innate ideas or *a priori* truths that are the starting-points for all demonstration and all science. When these are once discovered, it is the further task of philosophy to deduce by logical reasoning the further results that follow from them. In this way the rationalists supposed that it was possible to arrive at conclusions in philosophy that are as demonstrably certain as the propositions of geometry.

Besides Descartes, the chief representatives of rationalism are Spinoza (1632-77), who adopted the geometrical form of proof in his chief work, the 'Ethics'; Leibnitz (1646-1715), and Christian Wolff (1679-1754). The last mentioned philosopher, though the least original, exercised a great influence over the thought of Germany by his terminology, and by the systematic way in which he divided the field of philosophy into the so-called sciences of rational cosmology or physics, rational psychology, and rational theology. The first of these seeks to furnish demonstrative proof of the fundamental nature of the physical universe; for example, that it is limited in space, had a beginning in time, made up of indivisible parts, etc. Rational psychology sets out from the conception of the soul as a spiritual substance and attempts to prove that it necessarily follows as a result of this initial conception, that the soul is simple, indivis-

ible, indestructible, and therefore immortal, and moreover, that it possesses certain faculties, such as those of representation, desire, as essential to its true nature. In like manner, rational theology dealt in the same *a priori* and deductive way with the various proofs for the existence and attributes of God. This was the form of rationalism in which Kant was educated, and it is against these so-called rationalistic sciences that he directs his attack in the dialectic of the 'Critique of Pure Reason.' The criticism of Kant was so penetrating and thorough-going that it annihilated at a blow the claims of rationalism. It did this by pointing out, in terms that could neither be mistaken nor denied, the falsity of the assumptions upon which this philosophical theory rests. Kant (q.v.) is thus the destroyer and finisher of rationalism.

Consult: Lecky, 'History of the Rise and Influence of Rationalism in Europe'; Stephen, 'History of English Thought in the Eighteenth Century'; White, 'The Warfare of Science and Religion'; Paine, 'Age of Reason'; Cairns, 'Unbelief in the Eighteenth Century' (1881); Descartes, 'Discourse on Method'; 'Meditations on the First Philosophy'; Zeller, 'Geschichte der deutschen Philosophie seit Leibnitz'; Windelband, 'History of Philosophy' (translated by J. H. Tufts); Kuno Fischer, 'Geschichte der neueren Philosophie,' Vol. III.; Kant, 'Critique of Pure Reason.'

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Rationalists. See RELIGIOUS SECTS.

Ratisbon, rät's-bön (Regensburg, rä'gëns-boorg), Bavaria, Germany, 82 miles by rail northeast of Munich, partakes of the artistic tendencies of the latter. Chief among its public buildings and institutions are the Gothic cathedral, library, art-gallery, seminaries and glass-staining factory. Trade, facilitated by its favorable position on the Danube, is considerable. Ratisbon suffered much from bombardments at various periods of its history, especially in 1809, when it was stormed by the French. Pop. about 47,000.

Ratitæ, rā-ti'tē, a group of birds broadly characterized as having a non-carinate sternum and little or no power of flight. The group originally was one of the two grand divisions of *Aves*, embracing all those whose sternum had no keel, as opposed to *Carinata* (q.v.); but this character alone will not define the *Ratitæ* as at present constituted by the researches of Gadow and accepted by ornithologists generally. Its place is as a subdivision of the *Neornithes* (q.v.) co-ordinate with the *Odontolæ* (*hesperornis*, etc.) and the *Carinata*; and the sum of many anatomical peculiarities distinguishes the group, which consists of the ostriches, cassowaries, kiwis, moas, rocs (*Æpyornis*), and perhaps some of the fossil birds of Patagonia whose relationships are not yet perfectly clear. The conspicuous feature of all these is the rudimentary condition of the wings, so that the ratites are well designated flightless birds, the disappearance of the tail, and the great prominence of the functions and development of the legs and feet. These features are believed to be the result of changes, very long continued, from ancestors which possessed the power of flight and have lost it by disuse, and in adaptation to life upon

RATKE — RATTAZZI

plains and deserts. Consult: Evans, 'Birds' (1900); Newton, 'Dictionary of Birds' (1893-96); Stejneger, 'Standard Natural History,' Vol. IV. (1885).

Ratke, rät'kē, Wolfgang (better known by his Latinized name of RATCHIUS), German educator: b. Wilster, Holstein, 18 Oct. 1571; d. Erfurt 27 April 1635. He was trained in the Johanneum at Hamburg and the University of Rostock. Between 1603 and 1611 he lived in Holland and was the inaugurator of a new plan of school reform. The essence of his system was to discard the old memory and rote method of teaching children; to interest them, by presenting things to their observation, and afterwards, names—a reversal of the method then in vogue; to teach them their mother tongue first and thence proceed to foreign languages. At first he met with little success in propagating his views. In 1618, however, he settled at Köthen, Anhalt, and Prince Ludwig von Anhalt furnished him with the means of opening a school to be conducted according to his own ideas. Owing to certain faults of his own, as well as to the unsettled religious condition of Germany at that time he was obliged to leave Köthen and settled at Magdeburg in 1721. Here he made a second failure and afterward led a somewhat wandering life. But his influence upon his contemporaries and posterity was much greater than would be supposed from the failure of his own attempts to put his plan in practice. Consult: Krause, 'Wolfgang Ratke, im Licht seiner und seiner Zeitgenossen Briefe' (1872); Schumann, 'Die echte Methode W. Ratkes' (1876).

Raton, ra-tōn', N. M., city, county-seat of Colfax County; on the Atchison, Topeka & Santa Fé railroad; about 130 miles northeast of Santa Fé and eight miles south of the northern boundary of the Territory. In the vicinity are extensive coal fields. It is the commercial and industrial centre of a large region devoted chiefly to farming and stock raising. It has railroad shops, stock yards, grain elevators, wholesale houses, and brick and lumber yards. Pop. (1910) 4,539.

Rattan', a product of *Calamus rotang*, a scandent palm of Ceylon, but also found in India and Burma. While this species furnishes the best commercial rattan, there are nearly 200 species in this genus, inhabiting tropical and subtropical Asia, Africa, and Australia. The most important species other than the above are *C. rudentum*, *C. pachystemonus*, and *C. radiatus*, abounding throughout the damp forests of Ceylon up to 3,500 feet elevation. *C. rotang*, and the first two species named above are manufactured into a great variety of useful articles such as baskets, chairs, the hoods of carts, and when split into strips, can be twisted into cordage of great strength. *C. rotang* is often used in eastern countries for rope bridges, or, used entire, is stretched across rivers as the supports of suspension bridges; and is also employed for the manufacture of Malacca canes. In China rattan is a favorite material for cordage, and the material also enters into the manufacture of umbrella handles and ribs, and as a substitute for whalebone. The cane is used for saddlery and harness and for wickerwork helmets, said to be sword-proof. The two smaller species (*C.*

pachystemonus and *C. radiatus*) are largely employed in the manufacture of baskets for the Ceylon tea gardens, used in picking the tea leaves. *C. radiatus* supplies the material for chair bottoms, being split into thin strips. In fact the many uses of rattan in eastern countries are almost nameless. In the United States rattan is largely used for manufacturing chairs and other furniture, for chair-seating, baby-carriage bodies, baskets, floor mattings, brooms, corset-stays, whips, and many other uses of minor importance. The "reed" used in raffia fancy-basket manufacture, a recent fad in this country, is the split inner portion of rattan dressed in cylindrical form like the true reeds. See also FIBRE.

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Rat'tany, or Rhatany, a coarse plant of the genus *Krameria* and order *Polygale*, native to the Andean table-lands. The roots have medicinal value as an astringent, and serve, especially in Portugal, to color wines ruby-red. This property is due to the presence of ratanhia tannic-acid. The root-bark also contains an almost insoluble free red substance called ratanhia-red:

Rattazzi, rät-tät'sē, Marie Studolmine de Solms, French novelist: b. Waterford, Ireland, 1833; d. Paris February 1902. She was the daughter of Sir Thomas Wyse, British ambassador to Greece, and Letitia, eldest daughter of Lucien Bonaparte. She was married to Urbano Rattazzi (q.v.) in 1863, and to M. de Rute in 1877. Twice, in 1852 and 1864, she was exiled. She wrote much in prose and verse, and was a prominent figure in the politics and society of the Second Empire salons. Among her works were: 'Les Mariages d'une Creole' (1864); 'Si j'étais Reine' (1868); 'L'Aventurier des Colonies' (1885), a drama; and the volume of tales, 'Enigme sans Clef' (1894).

Rattazzi, Urbano, Italian statesman: b. Alessandria 29 June 1810; d. Frosinone 5 June 1873. He studied law at Turin and, after practising with marked success at the capital and at Casale, was elected a member of the Sardinian parliament from his native town in 1848. He allied himself with the liberal party and attained such speedy recognition that in August he was made minister of public instruction. He left office after a few days, but in December of the same year assumed the portfolio of the interior under Gioberti, exchanging it later for that of justice. On the fall of the Gioberti ministry, Rattazzi was entrusted with the formation of a new cabinet (February 1849) but the disaster of Novara in the following month robbed him of power. From democrat he now turned moderate liberal and formed the party of the left centre whose coalition with the right centre under Cavour (q.v.), the so-called "connubio," brought about the fall of the d'Azeglio cabinet in November 1852 and the organization of a new ministry by Cavour. Rattazzi gave up the presidency of the Chamber to become in 1853 minister of justice, and later, of the interior, and in the second capacity precipitated a bitter struggle with the clerical party by the introduction of a law providing for the partial secularization of church property and restricting the influence of the religious associations. He left the cabinet in 1858 but in

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July of the following year, after Villafranca, succeeded Cavour as head of the cabinet, only to give place to his predecessor within six months. He opposed the cession of Savoy and Nice to France, became president of the lower chamber in the first Italian parliament and in March 1862 succeeded Ricosoli in the government, retaining for himself the portfolios of foreign affairs and of the interior. His course in checking the patriotic agitation against the Austrians in Lombardy and the papal rule in Rome, brought him great unpopularity and in December 1862 he retired from office. Once more he succeeded Ricosoli, as premier, in 1867, but again had to yield to the storm of popular anger aroused by his hostile attitude toward Garibaldi (q.v.) and he resigned in October of the same year.

Rat'tigan, Sir William Henry, English jurist: b. Delhi, British India, 4 Sept. 1842. He was educated at King's College, London; admitted to the bar in 1873; served four times as judge of the chief court of Punjab; was additional member of the supreme legislative council of India 1892-3, and member of the Punjab legislative council 1898-9. In 1895 he was knighted and since 1901 he has been member of Parliament for northeast Lanarks. He has published 'De Jure Personarum' (1873); 'The Science of Jurisprudence' (3d ed. 1892); 'Private International Law' (1895); etc.

Rattlesnake, a distinctively American group of poisonous serpents characterized by a peculiar horny rattle appended to the tail. They belong to the suborder *Solenoglypha*, all the members of which are poisonous and have the fang-bearing maxillary bones erectile. To this suborder belong the Old World families of *Viperidae* (vipers) and the *Crotalidae*, or pit-vipers, which inhabit both hemispheres. The latter have the maxillary bone deeply excavated to lodge a sensory pit of unknown function opening on the face between the eye and nostril. There are two subfamilies, the *Lachesinae*, which have no caudal rattle, and the *Crotalinae*, or rattlesnakes. The former includes the copperhead, water moccasin and fer-de-lance (qq.v.), the banana snake, whose presence in bunches of this fruit so often causes consternation on fruit ships and in storage houses, and numerous others of tropical America, India, and the Malay Islands.

The *Crotalinae*, or rattlesnakes, represent the highest type of serpent development and specialization. The caudal rattle, from which they take their name, consists of a series of dry horny epidermal rings so loosely fitted that any movement causes them to knock together with a sharp rustling rattle. They are formed in the following manner: Several of the terminal vertebrae of the tail are coalesced to form a dilated vertically enlarged plate. This is covered with a thick vascular skin so cut by an annular constriction as to form a larger anterior, and a smaller posterior knob, which together may be considered to be a mold on which the joints of the rattle are formed. The epidermis covering this region is especially thick, and in the young snake forms a button and ring, which are the only indications of the rattle. When the snake sloughs, the horny covering is loosened here as elsewhere and a new

layer is formed beneath it; but instead of being cast off with the rest of the epidermis, the open end of the old horny ring fits over and by its elasticity clasps the new knob at the end of the tail, and by this means remains attached. With each subsequent molt a new ring and button are added, the latter serving to hold its predecessor in the series, and which continue to increase in size with the growth of the snake and its caudal knob. As well-fed snakes may slough 3 or 4 times a year, and as the rings sooner or later become worn out and detached, it is evident that the popular belief that the number of joints in the rattle indicate the years of the snake's age is unfounded. Rattles of more than 12 joints are rare, but one having 21 is known. When the snakes are irritated or angry, the end of the tail is more or less elevated and vibrated rapidly, producing a sound audible at a distance of 30 or 40 paces. Many snakes, both venomous and innocuous, have this habit of vibrating the tip of the tail when angry and many have a hard horny spur or cap at its end, but no others retain this through a succession of molts. Many fantastic theories have been proposed in explanation of the utility of the rattle, but it is probably little more than a recognition character, which helps to bring the sexes together and to segregate the species. However, it is probable that its sounding formerly saved the lives of many rattlesnakes by warning large animals acquainted with their deadly powers from the vicinity, but since the advent of the white man it has had a precisely opposite result.

Poison.—The venom apparatus of the rattlesnakes is the most complete and effective contrivance imaginable for injecting the poisonous fluid into the circulation of a victim. The maxillary bones are very short and are freely movable on an articulation with the prefrontals. Upon them are attached the venom fangs at such an angle that with the movements of the maxillary they may be depressed in a fold of mucous membrane or erected vertically in the very front of the mouth in a most effective position for striking. The tooth substance of the fang is folded into a tubular form, with an opening at the base to receive the end of the venom duct and another near the front face of the needle-pointed tip. Behind the functional fang, which may be nearly an inch long in large snakes, is a succession of smaller reserve fangs, which become functional in order as their predecessors are lost. The venom gland, which corresponds to the parotid salivary gland of other animals, is situated on the cheek and has a duct running to a sinus at the base of the fang. All of the muscles and other parts are so arranged that the same movements that open the mouth and press the horizontal pterygoid bones forward to erect the maxillaries with their fangs, also compress the poison gland and squeeze out its secretion. Cope describes the biting movement as threefold. "First, there is the spring of the body, which never exceeds two thirds of its length; second, the bite proper, caused by the seizing of the jaws; and, third, the clutch with the fangs themselves, which are moved freely backward and forward." This movement of the fangs may be easily seen by holding a rattlesnake so that it cannot strike, when drops

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of the pale yellow venom may be seen to fall from their tips and are sometimes blown from the mouth by forcible expirations. The active principles of the venom are several soluble proteids, one of which has a disorganizing effect on tissues with which it comes in contact and another is a powerful heart and respiratory depressor. The immediate effect of a bite is severe burning pain followed in 10 or 15 minutes by prostration, with dizziness, vomiting, and cold sweats; the heart action is very feeble and the pupil dilated. This condition gives way in from 12 to 15 hours to one of fever and difficult respiration, while the part affected becomes greatly swollen and the neighborhood of the wound suppurates. Death may occur in either of these stages or as a result of secondary gangrene. Treatment to be effective must be prompt and thorough. A ligature should be applied above the wound and the latter enlarged with a clean knife until the blood flows freely. Permanganate of potash, bleaching powder, chromic acid, silver nitrate or other substances, which render the active albumens insoluble should be applied to the wound. Small and frequent doses of whiskey, strychnine or ammonia should be administered as a stimulant, but an excess of alcohol may increase the depression. Every effort should be made to press or draw the poison from the wound before the ligature is removed, but sucking with the mouth is always dangerous.

Species of Rattlesnake.—Of rattlesnakes three species of *Sistrurus* and 16 of *Crotalus* have been described, three of which are South and Central and the rest North American. None occur in the West Indies. The species of *Sistrurus* are small snakes with the snout and frontal region of the head covered with large plates. The ground rattlesnake or massasauga (*S. catenatus*) is found on low prairie lands from Ohio and Minnesota southward, but is now rare or exterminated in all settled parts. It reaches a length of three feet and is not considered especially dangerous. About six young are born alive in September; and this is one of the snakes for which it is pretty clearly established that the newly hatched young seek refuge from danger in the mouth and gullet of the mother. A related species (*S. miliarius*) is found in the Southern States.

In the genus *Crotalus* the entire top of the head is covered with small scales. The common or banded rattlesnake (*C. horridus*) was formerly abundant throughout the entire eastern United States, and it is the only species found in the New England and Middle States, but has been largely exterminated by the white man and his companion, the hog. The latter in roaming the woods in search of mast, etc., never fails to kill and devour the rattlesnake whenever possible. It is commonly believed that the hog is immune to snake-bites, but the truth is that the poison is dissipated in the thick skin and layer of subcutaneous fat, and never reaches the vascular tissues beneath. This rattlesnake prefers sparsely wooded rocky ridges with sunny exposures and in such localities is still common in the mountains from Pennsylvania to Tennessee. It is a sluggish and generally peaceful creature and seldom bites, except to secure food, unless it be trod upon or startled. When about to strike it coils with the head in the middle and

elevated and the rattle sounding, delivers a lightning-like blow and immediately re-coils or slowly retreats. It seldom attacks without provocation, or follows a foe. All kinds of small mammals, especially mice, and occasionally birds are its food, and it drinks water freely. The cold months of the year are passed in hibernation and frequently large numbers of these snakes congregate in caves or beneath rocks for this purpose. Mating takes place in the early summer and about September from six to nine young about nine inches long are born alive. A length of five feet is sometimes attained, but ordinary examples seldom exceed four. Among the natural enemies of the rattlesnake are the king-snake and blacksnake, birds of prey and herons. The diamond or water rattlesnake (*C. adamanteus*) reaches a length of upward of eight feet and a circumference of fifteen inches, and is not only the largest of the rattlesnakes, but the bulkiest of all poisonous snakes, being exceeded in length only by the slender snake-eating cobra. It inhabits the Southern States and is particularly abundant on the Florida Keys. Except that it prefers the vicinity of water, in which it swims freely, its habits are much like those of the common species. Because of its great size, and the large amount of venom which it secretes, this is an extremely dangerous reptile; it is also sometimes inclined to be aggressive. The prairie rattlesnake (*C. confluentus*) inhabits most parts of the western plains and deserts, and is exceedingly abundant in unsettled regions. This is the species which plays a part in the famous triple alliance of prairie-dog, owl and rattlesnake, which, although popularly supposed to be a most amicable arrangement, is at best a state of armed neutrality and frequently of open warfare. The owls and snakes seek the burrows of the marmot as safe retreats and nesting sites, as well as for the purpose of feeding on the young marmots, while the latter frequently show their resentment of the intrusion in a variety of ways. A very distinct species is the horned rattlesnake (*C. cerastes*), in which the superciliary scales are produced into a pair of prominent horns surmounting the eyes. It is abundant in the desert region of the Southwest, especially about Death Valley, and is known in Arizona as the sidewinder from its peculiar habit of retreating sidewise from an intruder. Numerous other species inhabit these same hot dry regions.

Rattlesnakes possess a certain economic importance. As checks on the increase of the native mice and rats, they, in common with many other snakes, perform an important service. Their venomous qualities are such a menace to man and beast as to render their destruction both expedient and certain in all thickly settled districts. By the Indians and by the whites in certain parts of the South their flesh is relished; an oil or salve, supposed by the credulous to possess peculiar medicinal virtues, is claimed to be manufactured from their livers and other fatty parts; and the use of the skin for making purses, belts and other small articles is well known. Certain tribes of Indians employ these snakes in their ceremonials and others formerly poisoned the tips of their war-arrows with rattlesnake venom, while the rattles always figured among the charms of the medicine-man.

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Bibliography.—Cope, 'Report U. S. National Museum for 1898'; Stejneger, 'The Poisonous Snakes of North America' (1893); Mitchell and Reichert, 'Researches Upon the Venom of Poisonous Serpents' (Washington, 1886); Ingersoll, 'Country Cousins' (New York, 1885).

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Rattlesnake Root. See POLYGALA.

Rattlewing, a duck. See GOLDEN-EYE.

Rau, row, Charles, American archæologist: b. Vervien, Belgium, 1826; d. Philadelphia, Pa., 25 July 1887. He was educated at the University of Heidelberg and came to this country in 1848, where he engaged in teaching. From 1875 until his death he was curator in the National Museum at Washington, D. C., and devoted himself to the study of American archæology, on which he became a recognized authority. He wrote: 'Early Man in Europe' (1876); 'The Palenque Table in the United States National Museum' (1879); 'Articles on Anthropological Subjects, 1853-1877' (1882).

Rauch, rowh, Christian Daniel, German sculptor: b. Arolsen, Western Germany, 2 Jan. 1777; d. Dresden 3 Dec. 1857. In Arolsen he received his first instruction in art from the sculptor Valentin, under whom he executed ornamental work chiefly. Going to Cassel he became a pupil of Kuhl, the sculptor, and was appointed groom of the chamber in the king's household at Berlin. This gave him an opportunity of advancing in his art, and in 1802 he exhibited his 'Sleeping Endymion' and modeled a bust of Queen Louise (1804), which he subsequently executed in marble at Rome. In this city he found a patron in Humboldt, as well as in the first sculptors of the time, Canova and Thorwaldsen. Among his Roman work of early days must be mentioned the busts of the poet Werner, and the life-sized busts of Queen Louise, Count Wenyski, and the painter Raphael Mengs, executed under the commission of Ludwig of Bavaria. His colossal bronze statues of Blücher are 13 feet in height, and he also executed the greater part of the 12 statues in iron which compose the national monument at Kreuzberg, near Berlin. One of his finest works is the group 'Faith, Hope and Charity,' which he presented to his native town Arolsen, while his crowning work as a portrait and historic sculptor is his statue of Frederick the Great at Berlin (1851). He was one of the first, if not the very first, among German sculptors of his time, combining in his work the pure lines of transcendent dignity and grace with genuine portraiture of the individual. There is a poetic freedom in his conception of ideal subjects which does not yet overstep the limits of truth and fidelity to nature, and he may be safely styled the founder of the great Berlin school of sculpture. Consult: Eggers, 'Chr. D. Rauch' (1873); 'Rauch und Goethe, urkundliche Mittheilungen' (1880).

Raues Haus, row'es hows (corrupted from "Ruges Haus"), an educational and benevolent institution at Horn, near Hamburg, founded in 1833 by J. H. Wichern, who long remained at its head. It is connected with the German Home Mission, and besides forming a refuge for neglected children, receives boarding pupils from the higher classes, and serves as a train-

ing school for those wishing to become teachers, superintendents, or assistants in hospitals, reformatories, houses of correction, and the like. It is supported by voluntary contributions, the profits arising from the productive enterprises carried on in connection with it, and the fees of the richer pupils. In 1903, about 90 poor children were receiving instruction within its walls. They live in "families" of from 12 to 15, each "family" being under the care of one of the adult members of the mission training school. The educational department is in the hands of assistants, who also take part in the instruction of the institution, in order to prepare themselves for the work of the Home Mission in other localities. This indeed has become one of the most important features of the work carried on by the Rauhes Haus, and its graduates are found in every field of charitable work in Germany. The whole staff of assistants, consisting of young men of 20 to 29 years of age, are formed into a kind of society (*Brüderschaft*). Since 1844 the institution has carried on a printing and book-binding business. Its organ is the 'Fliegende Blätter.'

Raum, rowm, Green Berry, American lawyer: b. Golconda, Ill., 3 Dec. 1829. He was admitted to the bar in 1853; removed to Kansas and served in the Union army in the Civil War, rising to the rank of brigadier-general of volunteers. He sat in Congress 1866-9; was commissioner of internal revenue 1876-83, and United States commissioner of pensions 1889-93. He has published: 'The Existing Conflict' (1884); 'History of Illinois Republicanism' (1900).

Raumer, row'mër, Friedrich Ludwig Georg von, German historian: b. Wörlitz, near Dessau, Anhalt, 14 May 1781; d. Berlin, Germany, 14 June 1873. He studied law at Halle and Göttingen, and entered the Prussian state service in 1801. In 1811 he accepted the chair of political economy at Breslau, and in 1819 was called to Berlin. He was for some time secretary of the Berlin Academy, and at different times between 1816-55 traveled extensively through Europe and the United States. In 1848 he was elected to the Parliament of Frankfurt, and was sent to Paris as ambassador. He was a member of the House of Lords of Prussia from 1851 until his death. He founded and edited in 1830-67 'Historisches Taschenbuch.' The first scientific historian to popularize history in German, Von Raumer wrote: 'Geschichte der Hohenstaufen und ihrer Zeit' (1823-5); 'Geschichte Europas seit dem Ende des 15. Jahrhunderts' (1832-50); 'Die Vereinigten Staaten von Nordamerika' (1845); 'Handbuch zur Geschichte der Litteratur' (1864-6).

Raumer, Karl Georg von, German geologist and educator, brother of the preceding: b. Wörlitz, Germany, 9 April 1783; d. Erlangen, Germany, 2 June 1865. He was educated in Göttingen, Halle, and Freiberg, and in 1811 became professor of mineralogy at Breslau, was called to Halle in 1819, and in 1827 settled permanently as professor of natural history at Erlangen. He published: 'Geognostische Fragmente' (1811); 'Lehrbuch der allgemeinen Geographie' (1832); 'Geschichte der Pädagogik' (1843-51); etc. Consult his autobiography (1866).

Raumer, Rudolph von, German philologist, son of Karl Georg von Raumer: b. Breslau, Ger-

many, 14 April 1815; d. Erlangen, Germany, August 1876. He was privat-docent at Erlangen in 1840-6; professor there in 1846-76, and published: 'Untersuchungen über die Urverwandtschaft der semitischen und indo-europäischen Sprachen' (1868 et seq.).

Raupach, row'pāh, **Ernst Benjamin Salomo**, German dramatic poet: b. Straupitz, near Liegnitz, 21 May 1784; d. Berlin 18 March 1852. He studied at Halle, afterward went as a tutor to Russia, and in 1816 obtained a chair in the philosophical faculty of the University of Saint Petersburg; but quitted the country in 1822, and after various changes finally settled, in 1824, in Berlin, where he employed himself chiefly in writing for the stage. His dramatic works have been collected and published in two divisions, the one containing his comic pieces, under the name of 'Dramatische Werke komischer Gattung' (1828-35); and the other, 'Dramatische Werke ernster Gattung' (1830-43). In his earlier works he was an imitator of Schiller, and some of the tragedies belonging to this period, such as 'Die Erdennacht,' show much real power. His popular success was considerable; but his dramas became more and more trivial in content. They display, however, considerable knowledge of stage effect, great creative power, and a wealth of verbal wit. A life of the dramatist was published by Pauline Raupach (1853).

Raupp, rowp, **Karl**, German painter: b. Darmstadt 1837. He began as a landscape painter, and between 1856 and 1858 studied genre under J. Becker at Frankfurt, and under Karl Piloty at Munich Academy from 1860 to 1865. Subsequently he opened a studio, taking private pupils in painting, and in 1868 his reputation as a teacher gained for him the position of professor in the art school at Nuremberg, which he held up to 1879, when he was appointed professor in the Academy at Munich. Among his works may be mentioned: 'A Boating Party on the Chiem See'; 'Home Before a Storm'; 'A Calm'; 'Ave Maria'; 'Sport and Work'; 'Starting Home from the Monastery School.'

Ravaillac, François, frāñ-swā rā-vā-yāk, French assassin: b. Tournes, near Angoulême, 1578; d. Paris 27 May 1610. He was successively valet to an attorney, in which situation he learned to read and write; attorney's clerk, and schoolmaster. He could never succeed in any undertaking, however, and was thrown into Angoulême prison for debt, where he remained for a considerable time. At last he was released, and turned out into the world a beggar. He entered the order of the Feuillants, but was expelled shortly afterward as a visionary. His naturally gloomy disposition degenerated into fanaticism when he began to meddle in the religious controversies that distracted France. He came to consider King Henry IV. as the arch enemy of the Church, to destroy whom would be a meritorious work. On 14 May 1610, while the king's carriage was standing in the street, Ravaillac approached and stabbed him. He was condemned to be torn to pieces by four horses, and this he underwent, previously declaring that he had no accomplices to his crime.

Ravana, rā'vā-nā, in Hindu mythology the Rakshasa, who, at the time of Rama, ruled over Lanka or Ceylon, and, having carried off Sita, the wife of Rama, to his palace, was ultimately

conquered and slain by the latter. He is described as a giant with 10 faces, who in consequence of austerities and devotion, had obtained from Siva a promise which bestowed on him immunity from the power of demons and gods. Vishnu became incarnate as Rama, and hence killed the demon giant, whose kingdom had been invaded by men with the assistance of monkeys, against whom Ravana, in scorn, had omitted to make any stipulations in his compact with Siva.

Raven, a typical species (*Corvus corax*) of the crow family (*Corvidæ*), of which, as indeed of all passerine birds, it is the largest representative. The size is quite variable, but is generally about two feet in length and four feet in expanse. Plumage, bill, and feet are all black, the former with rich purple and violet lustres, but duller in the young and females, which are likewise smaller. The raven inhabits Europe, a large part of Asia, and North America from the Arctic Ocean to Guatemala. In North America two sub-specific forms are found, *C. corax sinuatus* being the western, and *C. corax principalis* the larger northern and eastern race. The former is generally abundant in the Rocky Mountain region; the latter has been largely exterminated in the eastern United States, but is still found in many inaccessible waste and mountain districts and reaches a very large size in Labrador and northward. Northwardly the raven is migratory, but may withstand the cold of the severest winters, as it often does in Canada and about the Great Lakes.

It is most abundant in rocky districts, near the banks of lakes and rivers, and is generally seen alone or in pairs, but sometimes in small flocks after the breeding season; the flight is rapid, elevated, and protracted, often sailing for hours at a time at a great height; on the ground the gait is grave and dignified, with frequent opening of the wings. It is truly omnivorous, but by preference carnivorous, eating small animals of all kinds, eggs, and young birds, carrion, dead fish, mollusks, crustaceans, insects, nuts, and berries. The European raven is reputed to destroy young rabbits and even lambs. It disgorges indigestible substances, as bones, hair, and feathers, like birds of prey. It is very wary and cunning, and is rarely caught in traps or shot by the hunter, but it often falls a victim to the poisoned baits set by the trappers for the fur-bearing animals. It breeds, according to latitude, between January and June, making a rude nest on inaccessible cliffs or tall trees, repairing the same for years in succession; the eggs are four to eight, two inches long, light greenish blue with numerous light purple and yellowish brown blotches, especially at the larger end; incubation lasts about three weeks, and the young remain in the nest several weeks before they are able to fly, fed at first on the half digested food disgorged by the parents; only one brood is raised in a year, and this is bravely and successfully defended against the largest birds of prey. The raven is easily domesticated by kindness, and becomes much attached to its master, following him like a dog. Like others of the family it can be taught to imitate the human voice and to pronounce a few words with great distinctness; but the natural note is a deep, hoarse croak. The white-necked raven (*C. cryptoleucus*) of Mexico and the south-

western United States has the concealed bases of the neck feathers pure white. Several other raven-like species inhabit Africa. The large size, black color, mournful croak, charnel-house habits, together with the boldness, sagacity and wariness of the raven have combined to make it an object of superstitious fear and hate. As a bird of ill omen it was watched by the ancient augurs with close attention; it holds a prominent place in mythology and folklore, and receives frequent notice in literature.

Ravenel', Harriott Horry, American biographer: b. Charleston, S. C., 12 Aug. 1832. She was married in 1851 to St. Julien Ravenel M.D. She is a prominent member of the Society of Colonial Dames of America. She has published 'Ashurst' (1870); 'Life of Eliza Pinckney' (1896); 'Life and Times of William Lowndes of South Carolina' (1901).

Ravenel, Henry William, American botanist: b. Berkeley, S. C., 19 May 1814; d. Aiken, S. C., 17 July 1887. He was graduated from South Carolina College in 1832, made a life study of the fungi and cryptogams and became one of the best botanical authorities in the United States. He made a critical study of the phænogams of South Carolina, was botanist of the government commission to Texas in 1869, and was agricultural editor of the 'Weekly News and Courier.' The genus *Ravenelia* of the *Uredineæ* is named in his honor. He wrote: 'Fungi Caroliniani Exsiccati' (1853-60); and with M. C. Cooke 'Fungi Americani Exsiccati' (1878-82).

Ravenna, ra-vën'a (It. *rā-vën'nā*), Italy, (1) capital of the province of the same name, 45 miles east of Bologna. Though standing in a low marshy plain it was once a flourishing city, and the seat of the exarchate of Ravenna of the Western Roman Empire, close to the Adriatic Sea, but now five miles distant. Laces, wines, and agricultural implements form the chief articles of trade. The salient points of interest are found in its ancient churches, museums, tombs, and historical landmarks, among which may be mentioned the palace and tomb of Theodoric, the temple containing Dante's tomb, and Lord Byron's house. Pop. about 65,000. (2) The province has an area of 715 square miles.

Ravenna, ra-vën'a, Ohio, village, county-seat of Portage County; on the Baltimore & Ohio, the Erie, and the Pennsylvania R.R.'s; about 28 miles southeast of Cleveland. It is in an agricultural region, and has extensive industrial interests. The chief manufacturing establishments are foundries, machine shops, furniture factories, brick and tile works, electrical supply works, flour and lumber mills, iron and boiler works and cigar factories. It has a large trade in farm, clay, and iron products, and in livestock. In the vicinity are a number of small and beautiful lakes, which have been made popular outing places. Pop. (1890) 3,417; (1900) 4,003; (1910) 5,310.

Ravenna Grass. See GRASSES IN THE UNITED STATES.

Ravenscroft, rä-vënz-kröft, Edward, English dramatist, who flourished between 1671 and 1700. He was exceedingly popular in his day, though his work was never original, consisting of translations from older plays, and at times he

even borrowed from his own previous works. His first play was 'Mamamouchi' (1671), taken from Molière's 'The Gentleman Citizen.' His plays include: 'The Wrangling Lovers' (1676), after Corneille; 'Scaramouch, a Philosopher' (1677); 'Dame Dobson' (1683); 'The Canterbury Guests' (1695); 'The Italian Husband' (1698); etc.

Ravenscroft, Thomas, English composer: b. near London 1592; d. London 1635. He was educated for his profession in St. Paul's choir, and at 15 received the degree of Bachelor of Music from Cambridge. In 1611 he published a collection of 23 part-songs, under the title 'Melismata,' which are of remarkable beauty. In 1614 appeared his 'Brief Discourses,' another collection of 20 part-songs to which he has prefixed an essay on the ancient musical modes. In 1621 he published his 'Whole Book of Psalms,' containing a chant for each psalm, many new, and all harmonized in four parts by Tallis, John Milton (the poet's father), Ravenscroft himself, and other musicians.

Ravenshoe, rä-vënz-hö, a novel by Henry Kingsley, published in 1862. The House of Ravenshoe, in Stonington, Ireland, is the scene of this novel; and the principal actors are the members of the noble family of Ravenshoe. The plot is remarkable for its complexity, and the book contains many bits of piquant humor.

Ravensstein, rä-vën-stin, Ernst George, Anglo-German geographer and statistician: b. Frankfort-on-the-Main 30 Dec. 1834. He was educated privately and in 1852 removed to London. In 1855-75 he was engaged in the topographical (now intelligence) department of the war office, was a member of the council of the Royal Statistical Society in 1877-92 and of the Royal Geological Society in 1894-6. He founded the German Gymnastic Society in 1861 and served as its president for 10 years and in 1882-3 he was professor of geography at Bedford College. He has published: 'The Russians on the Amur' (1861); 'Geographie und Statistik des Britischen Reiches' (1863); 'Map, Equatorial Africa' (1884); 'The Strange Adventures of Andrew Battell' (1901); etc.

Ravesteijn, rä-vë-stin, Jan van, Dutch painter: b. The Hague about 1572; d. there 21 June 1657. He was elected into the old Painters' Guild of Saint Luke at The Hague in 1598; the new guild was organized in 1655, and a Jan van Ravesteijn is enrolled among its members, but this may have been his son who bore the same name. He probably began his artistic studies under Frans Hals. His special department was portrait, in which he took rank among the first painters of Holland. Two large pictures of his with grouped portraits are to be seen in the Hall of the Company of Archers at The Hague; and in that city and at Antwerp are several portraits of individuals. His portrait picture of his own family is at Brunswick. His faces are life-like, his handling vigorous, and his coloring transparent, although somewhat too red to be quite natural.

Ravignan, rä-vën-yän, Gustave Xavier Lacroix de, French Jesuit pulpit orator: b. Bayonne 1 Dec. 1795; d. Paris 26 Feb. 1858. He had already enlisted in the Bourbon cause in 1815, and, after juristic studies, been made auditor of the Paris supreme court (1817) and sub-

RAVEN TRIBE.

1. Jackdaw.
2. Magpie.
3. Raven.
4. Rook.
5. Gray Crow.



stitute attorney-general (1821), when in 1822 he entered the Jesuit novitiate at Montrouge. In July 1828 he was ordained priest, and subsequently was professor of theology at St. Acheul (1828-30) and at Brieg (Canton Wallis), Switzerland. He returned in 1835 to France, where he was for five years head of the Jesuit establishment at Bordeaux. In 1837 he took the place of Lacordaire (q.v.) at Notre Dame, and continued the "conferences" there until 1846. He spoke with much simplicity, but with intense conviction. Crowds flocked to hear him, the cathedral being, it is said, often filled hours before the sermon began. He has been considered one of the greatest preachers of his time. Among his writings were: 'De l'Existence et de l'Institut des Jésuites' (1844; 7th ed. 1855); and 'Clément XIII. et Clément XIV.' (1854). Consult the sketch by Ponlevoy (13th French ed. 1890; Eng. trans. 1873).

Ravine-deer, the name among East Indian sportsmen of the common gazelle of India (*Gazella bennetti*), which is numerous in open rocky places and on the plains from central India to Persia. See GAZELLE.

Ravogli, Augustus, American surgeon: b. Rome, Italy, 7 Feb. 1851. He was graduated from the University of Rome in 1873, studied medicine at Vienna, Prague, and Berlin, served as surgeon in the Italian army with the rank of major and came to the United States in 1880. He settled in Cincinnati, Ohio, in 1881, and shortly after became professor of dermatology and syphilography at the University of Cincinnati. He has published numerous scientific articles and 'The Hygiene of the Skin' (1888).

Rawal Pindi, râ'ûl pîn'dê, India, in the Punjab, (1) the administrative capital of the division and district of its own name between the Indus and Jhilam, on the railway from Lahore to Peshawar. It is modern in appearance, well-built, and an important grain market. There are an arsenal, a fort, a fine public park, several European churches and the headquarters of the Punjab Northern State R.R. Transit trade is carried on with Cashmere and Afghanistan. The Sikhs surrendered here, and in 1885 a great durbar or review was held. Pop. about 90,000. (2) The Rawal Pindi division comprises four districts with a total area of 15,435 square miles. The district contains many towns connected with the campaign of Alexander the Great. Pop. 3,560,699.

Rawdon, Francis. See HASTINGS, FRANCIS RAWDON.

Rawhide, a form of leather in which the curing process stops short of destroying the life of the material. The result is a material remarkable for toughness, durability, tensile strength, and pliancy. It is used for belting rope, hydraulic packing, laces of various kinds, pinion wheels, washers, harness, mauls and mallets, trunks, saddles, artificial limbs, whips, lariats, etc.

Rawle, râl, William, American lawyer: b. Philadelphia, Pa., 28 April 1759; d. there 12 April 1836. He studied law in New York and in London, was admitted to the Pennsylvania bar in 1783, in 1791 was appointed by Washington as district attorney of Pennsylvania, and in 1794 assisted in the prosecution of the offenders in the Whiskey Rebellion. He acted

as counsel for the United States Bank for many years, was chancellor of the Associated Members of the Bar of Philadelphia, and of the Law Association of that city, and was a trustee of the University of Pennsylvania from 1796 until his death. He assisted in the revision of the civil code of Pennsylvania in 1830, was one of the founders of the Historical Society of Pennsylvania in 1824, serving as its first president, and was also president of the Abolition Society. He published: 'A View of the Constitution of the United States' (1825); 'Discourse on the Nature and Study of the Law' (1832); etc. Consult Wharton, 'Mémorial of William Rawle' (1840).

Rawle, William Henry, American lawyer: b. Philadelphia 31 Aug. 1823; d. 19 April 1889. He was graduated at the University of Pennsylvania in 1841 and three years later was admitted to the bar, where he rapidly attained prominence. He enlisted in the Union army during the Civil War (1861) and re-enlisted in 1863, then serving as quartermaster. He was vice-provost of the Law Academy (1865-73) and vice-chancellor of the Law Association from 1880 to the time of his death. He published: 'Law of Covenants for Title' (1852); 'Equity in Pennsylvania' (1868); 'The Lease of the Educated Unemployed' (1885).

Rawlins, râ'linz, John Aaron, American military officer: b. East Galena, Ill., 13 Feb. 1831; d. Washington, D. C., 6 Sept. 1869. He took up the study of law and in 1854 began practice in his native town. In 1861, soon after the storming of Fort Sumter, he made a brilliant war speech at a meeting presided over by Ulysses S. Grant, who was so greatly impressed that he requested Rawlins to act as his assistant adjutant-general. He then entered the army, and throughout the war was Grant's closest friend and adviser. He took an active part in the campaigns of 1862-3, and was appointed brevet major-general 13 March 1865. He was a man of marked ability as a soldier, although he never had military training. General Sherman said that Rawlins "was an intense thinker and a man of vehement expression; a soldier by force of circumstances rather than of education or practice, yet of infinite use to his chief throughout the war and up to the time of his death." He was secretary of war during Grant's first administration.

Rawlins, Joseph Lafayette, American legislator: b. Salt Lake County, Utah, 28 March 1858. He received a classical education at the University of Indiana, but was not graduated, and was a professor at the University of Deseret in Salt Lake City 1873-5. He was admitted to the bar in 1875 and practised until 1892, when he was a successful candidate for Congress. Defeated for a second term in 1895 he was elected to the United States Senate in 1897, where in 1902 he was a member of the Committees on Foreign Relations, Immigration, Geological Survey, Indian Affairs, Pacific Railroads, Public Buildings and Grounds, and the Philippines.

Rawlins, Wyo., city, county-seat of Carbon County; on the Union Pacific Railroad; about 135 miles west by north of Laramie. It is the commercial centre of an extensive stock raising and mineral region. Its manufac-

tures are chiefly for local use; but the railroad shops give employment to a number of persons. It ships annually a large amount of minerals, sheep, wool, and live cattle. The State Penitentiary is at Rawlins. Pop. (1890) 2,235; (1900) 2,317; (1910) 4,256.

Rawlinson, râ'lin-sôn, George, English Orientalist: b. Chadlington, Oxfordshire, 23 Nov. 1815; d. London 6 Oct. 1902. Educated at Oxford, he took orders and was made a fellow and tutor of Exeter College in 1840. In 1845 he became sub-rector, delivered the Bampton lectures in 1859, and in 1861 was made Camden professor of ancient history. He received from Mr. Gladstone a canonry of Canterbury Cathedral in 1872, and in 1888 accepted the living of All Hallows, Lombard Street, London. An indistinct utterance interfered with his public speaking and his pulpit was mainly filled by proxy. His learning was large and various and his services to Biblical scholarship of the highest importance. With his brother, Sir Henry Rawlinson (q.v.), and Sir George Wilkinson he published an annotated edition of Herodotus (1858-60). Among his other works are: 'The Historical Evidences of the Truth of Scripture Records' (1860); 'The Five Great Monarchies of the Ancient World' (1862-7); 'Historical Illustrations of the Old Testament' (1871); 'The Sixth Great Oriental Monarchy, or the Geography, History, and Antiquities of Parthia' (1873); 'The Seventh Great Monarchy' (Persian Empire) (1876); 'The Origin of Nations' (1877); 'Saint Paul in Damascus and Arabia' (1877); 'History of Ancient Egypt' (1881); 'Religions of the Ancient World' (1882); 'The Antiquity of Man Historically Considered' (1882); 'The Early Prevalence of Monotheistic Beliefs' (1883); 'Egypt and Babylon from Scripture and Profane Sources' (1884); 'Religious Teachings of the Sublime and Beautiful in Nature' (1884); 'Ancient History' (1887); 'Ancient Egypt' (1887); 'Moses: His Life and Times' (1887); 'A History of Phœnicia' (1889); 'Isaac and Jacob: Their Lives and Times' (1890); 'Parthia' (1893); and others in the department of Biblical commentary.

Rawlinson, Sir Henry Creswicke, English diplomatist and Orientalist: b. Chadlington, Oxfordshire, 4 Nov. 1810; d. London 5 March 1895. He went to Bombay in 1827 as a military cadet in the service of the East India Company, at once applied himself assiduously to the study of the Oriental languages, and was soon in request as an interpreter. After five years' service with the First Bombay Grenadiers, he was employed in military work in Persia (1833-9). His stay in Persia had made him acquainted with the cuneiform inscriptions at Behistun, and on being appointed in 1844 consul at Bagdad he set himself to copy and decipher the chief inscription. The result was his great paper on 'The Persian Cuneiform Inscription at Behistun,' printed in the 'Journal of the Royal Asiatic Society' in 1846. Though not without important predecessors in the same field, Rawlinson is justly regarded as the chief founder of the study of Persian cuneiform, and the first successful decipherer of cuneiform writings. Having shown great zeal and ability in the discharge of political duties, he was raised in 1851 to the rank of consul-general. Resigning in 1855, he returned to England, and in 1856 was created

K.C.B., promoted lieutenant-colonel, and appointed a crown director of the East India Company. In 1858 he was elected to the House of Commons for Reigate as a conservative, and again sat there in 1865-8 as member for Frome. In 1859-60 he was minister-plenipotentiary at Teheran, in 1889 became a G.C.B., and two years later was created a baronet. Rawlinson received many honors both at home and from foreign countries. He was president of the Royal Asiatic Society in 1878-81 and of the Royal Geographical Society in 1871-2 and 1874-5. His chief published works are: 'Cuneiform Inscriptions of Western Asia' (1861-80; 2d ed. of Vol. I., 1891), with E. Norris, G. Smith, and T. G. Pinches; 'England and Russia in the East' (1875), a strongly anti-Russian pamphlet; notes in the translation of 'Herodotus' by his brother, George Rawlinson (q.v.), and many papers in the journals of the Royal Asiatic and Royal Geographical Societies. See the 'Life' by his brother (1898), with an introduction by Earl Roberts.

Rawnsley, rânz'li, Hardwick Drummond, English Anglican clergyman and poet: b. Henley-on-Thames 28 Sept. 1850. He was educated at Oxford, took orders in 1875, was vicar of Wray, Windermere, 1878-83, and has been vicar of Crosthwaite, Keswick, from the last named date. Among his many published works are: 'Sonnets Round the Coast'; 'Sonnets at the English Lakes'; 'Literary Associations of the English Lakes'; 'Village Sermons'; 'Sonnets in Switzerland and Italy' (1899); 'Memories of the Tennysons' (1900); 'Ruskin and the English Lakes' (1901); 'A Rambler's Note Book at the Lakes' (1902).

Rawson, râ'sôn, Albert Leighton, American author and artist: b. Chester, Vt., 15 Oct. 1829; d. New York November 1902. He studied law, theology, and art and traveled extensively in the Orient, later exploring the Indian mounds in the Mississippi Valley, and traveling in Central America and in the Hudson Bay territories. He founded the Theosophical Society in the United States, was adopted into the tribe of the Adwan Bedouins of Moab and initiated by the Druses in Mount Lebanon. His books, illustrated by his own maps and drawings, include: 'Bible Dictionaries' (1870-5); 'Antiquities of the Orient' (1870); 'Vocabulary of the Bedawin Languages of Syria and Egypt' (1874); 'Chorography of Palestine' (1880); 'The Unseen World' (1888); 'History of Mysticism'; etc.

Rawson, Edward Kirk, American educator: b. Albany, N. Y., 21 Feb. 1846. He was graduated from Yale in 1868, from Andover Theological Seminary in 1872, and was ordained in the Congregationalist ministry. In 1871-90 he was chaplain in the United States navy, serving at the Naval Academy from 1886, and in 1888-90 professor of ethics and English there. In 1897-1902 he was superintendent of naval war records and in 1902 he resumed his chair at the Naval Academy. He has published 'Twenty Famous Naval Battles: Salamis to Santiago' (1899).

Ray, Anna Chapin, American author of juvenile fiction: b. Westfield, Mass., 3 Jan. 1865. She was graduated at Smith College 1885; and in 1888 received the degree of A.M. She has published 'Half a Dozen Boys' (1890); 'Half a

Dozen Girls' (1891); 'Dick' (1896); 'Each Life Unfulfilled' (1899); 'Bumper and Baby John' (1903); 'By the Good Sainte Anne' (1905).

Ray, George W., American lawyer and politician: b. Otselic, Chenango County, N. Y., 3 Feb. 1844. He was educated at Norwich Academy; served in the Civil War as private and brigade clerk; then studied law, was admitted to the bar in 1867, and established a successful practice. In 1882 he was elected to Congress as a Republican, and served till 1885, and again from 1891 to 1903. He opposed the free silver bill of 1892, was chairman of the committee on invalid pensions and of the committee on judiciary. In 1902 he was made United States district judge for northern New York.

Ray, Isaac, American physician: b. Beverly, Mass., 16 Jan. 1807; d. Philadelphia, Pa., 31 March 1881. He was graduated from Bowdoin in 1827, practised medicine, and in 1841-5 was superintendent of the state insane asylum at Augusta, Maine. In 1845-66 he had charge of the Butler Hospital for the Insane at Providence, R. I., and then removed to Philadelphia, where he engaged in medical practice. He published: 'Conversations on Animal Anatomy' (1829); 'Medical Jurisprudence of Insanity' (1838); 'Education in Relation to the Health of the Brain' (1851); 'Mental Hygiene' (1863); 'Contributions to Mental Pathology' (1873); etc.

Ray, John (at an earlier period spelled by him WRAY), English naturalist: b. Black Notley, near Braintree, Essex, 29 Nov. 1627; d. there 17 Jan. 1705. He was educated at Trinity College, Cambridge, was made Greek lecturer in 1651, mathematical lecturer in 1653; humanity reader in 1655, and junior dean in 1658. He made long botanical and zoological tours in England, Scotland, and Wales; and in 1663-6 traveled about Europe with Francis Willoughby in an attempt to accomplish a systematic description of the entire organic world. It is thought that much of the credit bestowed on Ray as the founder of English natural history should properly attach to Willoughby. Ray was elected F.R.S. in 1667. Among his works are 'Catalogus Plantarum Angliæ' (1670), the basis of all subsequent English floræ; 'Methodus Plantarum Nova' (1682), giving a new system of classification; 'Historia Plantarum' (1686-1704). In 1844 the Ray society was founded at London for the publication of scientific works of established merit. Consult the 'Memorials' by Lankester (1844).

Ray, a group of elasmobranchs forming the suborder *Batoidei*. The skates and the rays are nearly allied to each other, and are recognized by their broad flattened bodies, which are generally of a rhomboidal shape, and consist in greater part of the enormously developed pectoral or breast fins, which are supported upon a modified portion of the anterior skeleton. On the upper surface of the disk-like body the eyes are borne, together with spiracles or apertures, by which water may be admitted to the gillsacs. The mouth, nostrils, and gill-openings (five on each side) are in the lower surface of the body. The mouth is generally furnished with broad flat teeth of rhomboidal shape, and is of small size. The tail is elongated and slender, and is generally armed with sharp spinous processes. (See STING-RAY.) Two or more

dorsal fins may exist, whilst the caudal or tail fin is heterocercal. These fishes produce eggs, which, like those of sharks, are enclosed in cartilaginous capsules, known as "mermaids' purses," etc. Occasionally the rays may attain very large dimensions, and weights. They are bottom-fishes, and feed upon other small fishes, crustaceans and mollusks. They swim chiefly by peculiar undulating motions of the edges of the pectoral fins. In the true rays (*Rajidae*) the snout is more or less pointed and prolonged, and two dorsal fins exist near the end of the tail. The most common members of this group are the sting-rays (q.v.). The European sharp-nosed ray (*R. oxyrinchus*) is a favorite French food-fish; the homelyn ray (*R. maculata*), also, is frequently sold in the London markets. The American species are called skates (q.v.). The eagle rays (*Myliobatidae*) possess projecting heads, with the pectoral fins extended laterally in a great degree so as to imitate wings. The teeth are hexagonal, flat, and pavement-like. The slender tail possesses one dorsal fin, and is armed with a notched spine. These include the California "batfish" (*Myliobatis californicus*), and a famous whip-tailed species of the Mediterranean (*M. aquila*). Allied to these are the huge blanket-rays (*Mantidae*), so much dreaded by swimmers and divers in all warm seas. Specimens weighing more than 1,000 pounds have been taken in the Mediterranean. (See DEVIL-FISH.) Other families are the sawfishes (*Pristidae*), the guitar-fishes (*Rhinobatidae*) and the electric rays or torpedoes (*Narcobatidae*), elsewhere described. See FISHES; ICHTHOLOGY.

Rayahs, rā'yāz, the Christian peasantry, laborers, and small farmers, who lived under Turkish rule, or rather misrule, in the Balkan peninsula. The word means "cattle," and as cattle these people were treated by their Turkish masters in Bosnia, Servia, Bulgaria, and the neighboring states.

Rayleigh, rā'li, **John William Strutt**, BARON, English physicist: b. 12 Nov. 1842. He was educated at Cambridge and became a fellow of Trinity College in 1866. From 1879 till 1884 he was professor of experimental physics at Cambridge, and since 1887 has occupied the chair of natural philosophy in the Royal Institution. He was secretary to the Royal Society from 1887 till 1896, and since the latter year has been scientific adviser to Trinity House. In addition to many contributions to the proceedings of scientific societies, Lord Rayleigh has written the article 'Optics' in the 'Encyclopædia Britannica' (9th edition) and a valuable work on 'The Theory of Sound' (1877-8; new ed. 1894-6). He was associated with Prof. William Ramsay in the latter's discovery in atmospheric nitrogen of a new gas, called by them argon, and forming approximately 1 per cent of the atmosphere.

Raymond VI., rā'mônd, count of Toulouse: b. 1156; d. 1222. He succeeded to the territory in 1194. He protected the Albigenses, against whom Pope Innocent III. sent an army in 1208 to avenge the assassination of his legate. Raymond's territories were ravaged, he himself excommunicated and his lands given over to Simon de Montfort. After the death of de Montfort at the siege of Toulouse in 1218 Raymond recovered his territories. But again

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espousing the cause of the Albigenses he was once more excommunicated.

Raymond VII., son of Raymond VI., and last count of Toulouse: b. 1197; d. 1242. He engaged with his father for the recovery of Toulouse from Simon de Montfort, and finally forced the latter's son Amalric, to a complete surrender. Forced to make peace with the Pope and the king of France in 1229, he ceded Narbonne and other estates to Louis IX. He made Alphonse, Count of Poitiers, his heir.

Raymond, Andrew Van Vranken, American college president: b. Visscher's Ferry, N. Y., 8 Aug. 1854. He was graduated at Union College 1875, and at the New Brunswick Theological Seminary 1878. He was pastor of the First Reformed Church, Paterson, N. J., 1878-81; Trinity Reformed Church, Plainfield, N. J., 1881-7, and of the Fourth Presbyterian Church, Albany, N. Y., 1887-94. He has been president of Union College since 1894.

Raymond, Bradford Paul, American Methodist clergyman: b. Stamford, Conn., 22 April 1846. He was graduated from the Theological School of Boston University, and ordained to the Methodist Episcopal ministry in 1874. He held successive pastorates in New Bedford, Mass., Providence, R. I., and in Nashua, N. H., and was president of Lawrence University from 1883-9. From 1889 until his resignation in 1907 he was president of Wesleyan University, Middletown, Conn. He has published 'Christianity and the Christ.'

Raymond, Evelyn Hunt, American writer of juvenile fiction: b. Watertown, N. Y., 6 Nov. 1843. In 1869 she was married to J. B. Raymond and at present (1904) resides in Baltimore. Among her many popular books may be cited: 'Little Red Schoolhouse' (1897); 'A Daughter of the West' (1899); 'Reels and Spindles' (1900); 'The Sun Maid' (1900); 'A Daughter of the Forest' (1902).

Raymond, George Lansing, American educator: b. Chicago, Ill., 3 Sept. 1839. He was graduated from Williams College in 1862 and from Princeton Theological Seminary in 1865. Entering the Presbyterian ministry he was pastor at Darby, Pa., 1869-73; professor of oratory at Williams 1874-80; was professor of oratory and æsthetic criticism at Princeton 1880-93 and of æsthetics at Princeton from 1893. Among his many published works in verse and prose are: 'Life in Song' (1886); 'Poetry as a Representative Art' (1886); 'Ballads of the Revolution' (1887); 'The Representative Significance of Form' (1900); 'The Aztec God and Other Dramas' (1902).

Raymond, Henry Jarvis, American journalist: b. Lima, N. Y., 24 Jan. 1820; d. New York 18 June 1869. He was graduated from the University of Vermont in 1840, went to New York, studied law, and contributed to 'The New Yorker,' a literary weekly published by Horace Greeley. Upon the establishment of the New York Tribune in 1841 he became assistant editor. While editorially connected with the 'Courier and Enquirer' (1843-51) he engaged with Greeley in a spirited controversy on the subject of Fourierism, which had at that time taken a strong hold upon the American people resulting in the establishment of communities more or less resembling Brook Farm.

He was elected to the State Assembly in 1849 and 1850, the latter year becoming speaker. In 1851 he established the New York Times, the first number being issued on 18 September. In 1854 he was elected lieutenant-governor of the State. He was one of the prominent organizers of the Republican party, and drew up the 'Address to the People,' promulgated by its first national convention held in Pittsburg February 1856. His choice for President in 1860 was William H. Seward, and he used his influence to place him in the cabinet after Lincoln's election. After the disaster at Bull Run he proposed a provisional government, feeling that Lincoln's policy was too hesitating. He was again member of the Assembly in 1861, where he was chosen speaker; and in 1864 was elected to Congress, giving his support to President Johnson's policy. He was the author of the 'Philadelphia Address' to the people of the United States, promulgated by the National Union Convention, which he helped to organize in 1866. He was an effective public speaker, and exerted a marked influence on the elevation of the tone of journalism. He wrote 'Political Lessons of the Revolution' (1854); 'Letters to Mr. Yancy' (1860); 'History of the Administration of President Lincoln' (1864); 'Life and Services of Abraham Lincoln' (1865). Consult Maverick, 'Henry J. Raymond and the New York Press for Thirty Years' (1870).

Raymond, John Howard, American educator: b. New York 7 March 1814; d. Poughkeepsie 14 Aug. 1878. He took his degree at Union College in 1832, entered the Baptist ministry, and in 1839 became professor of rhetoric and English literature at Madison University, and in 1850 removed to the newly established Rochester University as professor of belles-lettres. As an organizer of educational institutions he showed remarkable aptitude, performing that service for the Collegiate and Polytechnic Institute in Brooklyn in 1856 and for Vassar College in 1865. He filled the post of president and professor of mental and moral science at Vassar until his death. Consult his 'Life and Letters' (1880).

Raymond, John T., American actor: b. Buffalo, N. Y., 5 April 1836; d. Evansville, Ind., 10 April 1887. His original name was John O'Brien. His first appearance was at Rochester in June 1853, as Lopez in 'The Honeymoon.' In 1861 he made a great hit as Asa Trenchard in 'Our American Cousin,' and in 1867 went to England and appeared in this character in the company of E. A. Sothorn, who was the famous Lord Dundreary. In 1874 he achieved his greatest success as Colonel Mulberry Sellers in a dramatization of Mark Twain's 'Gilded Age.' He was widely popular and depicted certain types of broad, humorous character with great success.

Raymond, Rossiter Worthington, American mining engineer: b. Cincinnati, O., 27 April 1840. He was graduated from the Brooklyn Polytechnic Institute in 1858 and spent three years in study at Freiburg, Munich, and Heidelberg. Returning from Europe he entered the Union army and served from 1862 to 1864 as additional aide-de-camp with the rank of captain. From 1864 to 1868 he was consulting engineer in New York, at the end of which time he was appointed United States commissioner of mining

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statistics and held this post until 1876. From 1870 to 1882 he was lecturer on economic geology at Lafayette College. In 1875 he became New York state commissioner of electric subways for the city of Brooklyn. One of the original members of the American Institute of Mining Engineers, he became its vice-president in 1871, was its president 1872-4, and secretary 1884-8. He is a member of scientific and technical societies in Europe and America, including the Society of Civil Engineers of France. In 1903 he became lecturer on mining law in Columbia University. He has published: 'Reports on the Mineral Resources West of the Rocky Mountains' (1869-76); 'The United States Mining Industry'; 'Mines, Mills, and Furnaces'; 'Silver and Gold'; 'Brave Hearts,' a novel (1873); 'The Man in the Moon and Other People' (1874); 'The Book of Job' (1878); 'Camp and Cabin' (1880); 'A Glossary of Mining and Metallurgical Terms' (1881); 'Memorial of Alexander L. Holly' (1883); 'Life of Peter Cooper' (1901).

Raymond, Walter, English novelist: b. Yeovil, Somerset, 13 March 1852. He was educated at private schools, and was partner in a glove manufactory, but in 1895 gave up business for literature. Among his works, several of which appeared under the pseudonym "Tom Cobbleigh" are: 'Misterton's Mistake' (1890); 'Gentleman Upcott's Daughter' (1894); 'Love and Quiet Life' (1894); 'Tryphena in Love' (1895); 'Two Men o' Mendip' (1898); 'The Idler Out of Doors' (1901).

Raymond, William Galt, American civil engineer: b. Princeton, Ia., 2 March 1859. He was graduated at Washington University as a civil engineer in 1884; was instructor of civil engineering at the California State University 1884-90; was professor of geodesy, road engineering, and topographical drawing at the Rensselaer Polytechnic Institute 1892-1904, and since 1904 professor of civil engineering and director of the School of Applied Sciences at Iowa State University. He has published 'Plane Surveying' (1896).

Raymond, Battle of. After the battle of Port Gibson (q.v.), 1 May 1863, the Confederates fell back beyond the Bayou Pierre and destroyed the bridges. Gen. Grant followed on the 2d, occupied Port Gibson, and the same evening the Confederates continued their retreat across Big Black River, at Hankinson's Ferry, leaving a force behind to prevent the crossing, which was attacked on the morning of the 3d by Crocker's division of McPherson's corps. The Confederates stoutly contested the ground, retiring very slowly, until late in the day, when Logan's division came upon their flank, when they hastily crossed the river. McPherson's corps was moved forward to Hankinson's Ferry and McClernand's to Willow Springs, where they remained until the 7th, when, Sherman's corps having crossed the Mississippi, the advance was resumed, the main body of the army moving along the line of the Big Black toward Edwards' Station, midway between Vicksburg and Jackson, while McPherson, on the right, was directed upon Jackson, the capital of the State, 45 miles east of Vicksburg, and the geographical and railway centre of the State. On the night of the 11th

McPherson bivouacked five miles northeast of Utica, on the road to Raymond, and early in the morning pushed rapidly for Raymond, 18 miles from Jackson, hoping to capture some commissary stores, but before 9 A.M. Logan's division, in the advance, encountered a strong body of the enemy, upon which the division was deployed and continued its advance for two hours, when, coming to a small stream crossing the road about two miles from Raymond, Gen. Gregg's brigade of about 3,000 men, with two batteries, was seen beyond the stream, disposed to enfilade the road and bridge over the stream. Logan threw out skirmishers and advanced, bringing on a severe engagement, which continued more than two hours, when the leading brigade of Crocker's division came up to his support, upon which Gregg, leaving two disabled guns, abandoned the field and retreated toward Jackson, being joined on the way by Walker's brigade, and when overtaken by night, bivouacking five miles from the field. The Union loss was 66 killed, 339 wounded, and 37 missing. Gregg reported a loss of 73 killed, 229 wounded, and 204 missing. Consult: 'Official Records,' Vol. XXIV.; Grant, 'Personal Memoirs,' Vol. II.

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Raynaud's (râ-nôz') Disease, a vasomotor affection, occurring mostly in children and young adults, and characterized by coldness and whiteness of the toes, the tips of the fingers, the end of the nose and sometimes of the lobes of the ears. It may exist with other functional nervous disorders, such as hysteria and neuralgia, and occurs especially in persons of neurotic heredity or temperament. It was first studied by Raynaud in 1862. He believed that the local manifestations are due to constrictor spasm, probably originating in the gray centres of the spinal cord. No central lesions have been found. After exposure to cold, the toes, fingers, nose, etc., become cold, numb, and white (local syncope), and pricking draws no blood. When warmth and color return, there is frequently pain, also congestion, swelling and a purple color (local asphyxia). Either of these stages may be recovered from, or the second stage may end in gangrene of the parts (Raynaud's gangrene, local or symmetrical gangrene). Recurrences of the disease are common. The prognosis is not good, especially in debilitated children. For treatment avoid cold, use warm baths, electricity, and massage. Ichthyol ointment sometimes alleviates the pain. Other remedies should be advised by the physician.

Rayner, râ'nér, Emma, American novelist: b. Cambridge, England. She was graduated from Cambridge University, came to this country and was employed on the staff of the 'Youth's Companion' (1896-1902). She has published: 'Free to Serve' (1897); 'In Castle and Colony' (1899); 'Visiting the Sin' (1900); 'Doris Kingsley: Child and Colonist' (1901); 'Handicapped Among the Free' (1903).

Rayner, Isidor, American lawyer and politician: b. Baltimore, Md., 11 April 1850. He received his education at the University of Virginia, and entering on the practice of law, soon became one of the leaders of the Baltimore bar. In 1878 he was elected to the State legislature, serving later for four years in the State senate. In 1887 he entered Congress as a

member of the House of Representatives, where he participated in important legislation, and in February 1904 was elected to the United States Senate.

Raynouard, François Juste Marie, frānswā zhüst mā-rē rā-noo-ār, French poet and philologist: b. Brignoles, department of Var, 8 Sept. 1761; d. Passy 17 Oct. 1860. He studied for the bar at Aix and practised law at Draguignan with great success. Elected a deputy to the Legislative Assembly in 1791, he attached himself to the Girondins, and on the proscription of that party was thrown into prison. The fall of Robespierre set him at liberty, whereupon he resumed his profession of advocate in his native province and acquired a fortune. Having previously made two unsuccessful attempts to live by his pen, he once more settled in Paris, and wrote 'Socrate dans le Temple d'Aglaure' (1802), a poem which obtained a prize from the Institute. This was followed by two tragedies, 'Eléonore de Bavière' and 'Les Templiers,' the latter performed at the Théâtre Français in 1805 by order of Napoleon. In 1806 he was elected a member of the Corps Législatif. In 1817 he was nominated perpetual secretary of the Academy, a post he resigned in 1826, when the ministry presented to the chambers a bill which had for its object the limiting of the liberty of the press. Of most value to the world is the work in the field of Romance philology, his writings including: 'Grammaire comparée des Langues de l'Europe Latine dans leurs Rapports avec la Langue des Troubadours' (1821); 'Choix des Poésies originales des Troubadours' (1816-21); 'Lexique Roman, ou Dictionnaire de la Langue des Troubadours comparée aux autres Langues de l'Europe Latine' (1836-44); 'Observations Philologiques sur le Roman de Rou, et sur quelques Règles de la Langue des Trouvères au XIIe Siècle' (1829).

Razin, rā'zēn, Stenko, Russian bandit: b. —; d. Moscow 1671. He was the leader of Cossacks who plundered caravans and fisheries along the Volga. Being captured he was pardoned by Alexis, but rebelled again, and gathered about himself the dissatisfied elements, captured cities and ruled along the Volga as far as Nijni-Novgorod. He was finally taken and executed at Moscow. Thereupon he became the hero of epic song of the 17th century and was regarded as the champion of the people against the nobles. Magic powers were attributed to him.

Razor, the well-known keen-edged instrument for shaving off the beard or hair. Razors seem to have been in use at a very early period of the world's history. They were used by the ancient Egyptians. The Levitical code expressly forbade the shaving of the beard, and many Jews in some countries remove all superfluous hair with the scissors until this day. It is believed by many authorities that the primitive shaving-instruments were made of sharpened flints; the savages of Polynesia still use two pieces of flint of the same size, or pieces of shells or sharks' teeth ground to a fine edge, for this purpose. Among civilized nations the blade is metal, usually steel, the finest cast steel being preferred. The handles are made of a great variety of materials, as silver, ivory, tortoise-shell, bone, horn, etc. The Chinese and

Japanese razors are very rarely furnished with handles.

Razor-bill, or **Tinker**, a species of auk (*Alca torda*) intermediate in structure between the guillemots and the great auk; but characterized by its compressed, elevated, hooked, and furrowed bill, its peculiar stiff wedge-shaped tail and ample wings. It is about 18 inches long, generally black above and white below; but in the breeding plumage the head and neck become lustrous black all around, with a very characteristic fine white line running from the eye to the base of the bill. This bird is abundant in the North Atlantic, frequenting rocky islands and coasts to breed with puffins and guillemots, but at other seasons keeping farther out at sea, and in winter migrating as far south as the Mediterranean and the coast of New Jersey or even North Carolina. On the American side it breeds in the Bay of Fundy and in great colonies in the Gulf of St. Lawrence, about Labrador, etc. A single much blotched and streaked whitish egg, about three inches long, is deposited on a ledge or in a fissure of some precipitous rocky cliff. They feed upon floating refuse or fish, worms, etc., for which they dive or which they pursue in the water, using both wings and feet in swimming. When molested they sometimes fight viciously, at the same time uttering harsh cries. The large eggs are much gathered for food.

Razor-clam, or **Razor-fish**, a bivalve mollusk of the family *Solenidae*, known on all sandy shores. The shell is long and narrow, like a razor-handle, and gapes at both ends, the siphons are short, the foot is large and powerful. The shell is handsomely ornamented and in some tropical species is of great beauty. These mollusks always live buried in the sand in an upright position, leaving only an opening shaped like a keyhole, which corresponds with the two siphon tubes. They are generally found at a depth of one or two feet, and when they make their burrows, as they are often in the habit of doing, among the rocks, not even an iron hook can draw them from their retreat, but they may sometimes be beguiled by pouring salt water on the spot, deceiving them into the impression that the tide has risen and they may begin to feed. They are edible, but rather tough. A familiar and typical species on the eastern coast of the United States is *Ensis americana*. Consult Kingsley, 'Standard Natural History,' Vol. I. (1885).

Razorback, one of the large whales of the genus *Balanoptera*, called also finbacks and rorquals. (See FINBACK; WHALE.) Also a name for the thin and agile semi-wild hogs which range the woods in the less settled parts of the southern United States.

Re, rā, the sun god, first and most important of Egyptian divinities. Re is supposed to be the son of Neith (q.v.), the goddess of the upper air, and to have had for his wife Mout, the mother of nature. He had for children Athor, the light; Mu, the sunlight; and Mat, spiritual light, and was widely worshipped by the ancient Egyptians, and in course of time every local divinity became identified with Re; thus, Ammon became Ammon-Re; Sobk changed to Sobk-Re. The attempt to unify the personages of mythology under Re and thus erect a

monotheism is credited to Amenophis IV. of the 18th dynasty.

Ré, rā, or Rhé, Île de, France, a small, low-lying island three miles distant from the coast of the department of Charente-Inférieure, opposite the city of La Rochelle, from which it is separated by the Pertuis Breton. It is about 18 miles long and three broad and measures 28 square miles. The inhabitants are chiefly engaged in the preparation of salt, producing 32,000 tons annually. The west coast is rocky; on the east side there are some good harbors. Oyster farming has become an important branch of industry yielding 35,000,000 annually. Wine is made and exported. The chief town, St. Martin, was fortified by Vauban. Pop. of island about 15,000.

Reaction, in chemistry, a general term for any chemical change that is brought about by the mutual interaction of two or more substances. Reactions between two primitive substances may be conveniently divided into three classes, as follows: (1) Those in which the two substances combine additively, so as to form a single third substance by their union. (2) Those in which one of the primitive substances is broken up, the other primitive substance combining additively with one or all of its parts, so as to produce two or more new substances. (3) Those in which there is a double decomposition of the two primitive substances, the several parts of the first combining with those of the second so as to produce two or more new substances. The first of these is illustrated by the action of oxygen gas upon metallic sodium, the combination taking place additively according to the equation $2\text{Na} + \text{O} = \text{Na}_2\text{O}$. The second is illustrated by the action of chlorine gas upon an excess of methane (CH_4); methyl chloride and hydrochloric acid being formed (upon exposure to diffuse daylight) in accordance with the equation $\text{CH}_4 + 2\text{Cl} = \text{CH}_3\text{Cl} + \text{HCl}$. The third general type of reaction between two primitive substances (that, namely, in which there is a double decomposition) may be illustrated by the action of hydrochloric acid upon caustic potash, KOH , as indicated by the equation $\text{KOH} + \text{HCl} = \text{H}_2\text{O} + \text{KCl}$, the products of the reaction being water and chloride of potassium.

To describe chemical reactions in detail would be to discuss the entire subject of chemistry. Reference must therefore be made to the many articles in this encyclopædia in which different types of reactions are described. See, for example, AROMATIC COMPOUNDS; BENZENE; CHEMISTRY; EQUILIBRIUM, CHEMICAL; FATTY COMPOUNDS; SOLUTIONS; etc.

Read, rēd, George, American patriot and jurist, one of the signers of the Declaration of Independence: b. Cecil County, Md., 18 Sept. 1733; d. New Castle, Del., 21 Sept. 1798. He was educated at Chester, Pa., studied law, and was admitted to the bar in Philadelphia, soon afterward settling in New Castle, Del., where he practised his profession. He served as attorney-general for the crown for the counties of Delaware, Kent, and Sussex from 1763 to 1764, when he was elected a member of the first Continental Congress. Early an opponent of independence, at last he saw no alternative, and signed the petition to George III. and the Declaration itself. He was chairman (1775-7)

of the first naval committee of the colonies, and is to be considered as one of the chief founders of the primitive American navy. The new constitution of Delaware (1776) was drafted by him, and he was president of the convention which adopted it. He was made vice-president and acting president (governor) of the State of Delaware, whose laws he codified. In 1782 he was appointed judge of the United States Court of Appeals for Admiralty Cases. He was a delegate to the Annapolis Convention (1786) and to the Constitutional Convention (1787), and was elected to the United States Senate in 1789 and in 1791. Resigning in 1793, he became chief justice of Delaware, and held that office during the rest of his life.

Read, John Elliot, American journalist: b. Farmer, Philadelphia, for 12 years. He has educated in the public schools and has written much for agricultural, religious, and literary periodicals. He was associate editor of 'The Working Farmer' in New York 10 years, and was corresponding editor of 'The Practical Farmer,' Philadelphia, for 12 years. He has published: 'Farming for Profit' (1880); 'Life Triumphant: A Study of the Nature, Origin and Destiny of Man' (1900); and also wrote 'A Brief History of the 9th Century Earlier Arctic Explorations from the 9th Century to the Peary Expedition' as the concluding section of 'Nansen in the Frozen World' (1897).

Read, John Joseph, American naval officer: b. New Jersey. He was graduated from the United States Naval Academy in 1861, served under Farragut during the Civil War, and on the Atlantic blockades, and in 1866 was promoted lieutenant-commander. He has received steady advancement, was made rear-admiral in 1900 with command of the receiving-ship Richmond, and in 1901 was placed in command of the navy yard at Portsmouth, N. H.

Read, John Meredith, American jurist: b. Philadelphia, Pa., 21 July 1797; d. there 29 Nov. 1874. He was a son of George Read, signer of the Declaration of Independence, was graduated at the University of Pennsylvania in 1812, and admitted to the bar in 1818. In 1822-3 he occupied a seat in his State's legislature, and later as city solicitor drew up the first statement of the finances of Philadelphia. He was United States attorney for the eastern district of Pennsylvania in 1837-44, and served as solicitor general of the United States; attorney-general of Pennsylvania, and chief justice of that State from 1860 until his death. With the formation of the Republican party he became one of its members, and by it was elected judge of the supreme court of Pennsylvania in 1858. His name was proposed as candidate for the presidency of the United States in 1860 and several votes were actually cast for him in the Chicago convention, though he used his personal influence in favor of Abraham Lincoln. His 'Views on the Suspension of the Habeas Corpus' (1863) became the basis of the act of 3 March 1863, authorizing the President to suspend the habeas corpus act. His legal opinions extend through 41 volumes of reports, while of his published addresses the principal are: 'Plan for the Administration of the Girard Trust' (1833); 'The Law of Evidence' (1864); 'Jefferson Davis and his Complicity in the Assassination of Abraham Lincoln' (1866).

Read, John Meredith, American diplomatist: b. Philadelphia, Pa., 21 Feb. 1837; d. Paris 27 Dec. 1896. He was a son of Judge Meredith Read (q.v.), was graduated at Brown University, and at the Albany Law School in 1859. He pursued the study of international law in Europe, was admitted to the bar in Philadelphia, and settled at Albany. From 1860 to 1866 he was adjutant-general of the State of New York. In 1869 he was appointed United States consul for France and Algeria, and during the period of the Franco-Prussian war he acted as consul-general for the German government, for which he received the thanks of both the French and German governments, and personal recognition of his services from Prince Bismarck. From 1873 to 1879 he was United States minister to Greece, and during the latter part of his tenure of office personally paid the expenses of the legation, when the government refused the appropriation. His important services during his term were his securing the revocation by the Greek government of an order prohibiting the sale of the Bible in Greece; the release of the American ship *Armenia*, and the report of an open Russian port during the Turkish war, to which he urged the despatch of a grain fleet. After his relinquishment of diplomatic duties he continued to reside in Europe, engaged in archæological, historical, and art studies. He was the author of a 'Historical Inquiry Concerning Henry Hudson' (1866).

Read, Nathan, American inventor: b. Warren, Worcester County, Mass., 2 July 1759; d. near Belfast, Maine, 20 Jan. 1849. He was graduated from Harvard in 1781; studied medicine; in 1796 established with others the Salem iron foundry, where chain cables and other iron work for ships were manufactured, and in 1798 patented a nail-making machine. In 1788 he became interested in steam navigation, and as his first task attempted the construction of a boiler that should be at once compact, light, and safe. He made, in 1788 or 1789, the first drawings of what he styled his "portable furnace boiler," which was devised for use on steam carriages and steamboats, and for which he obtained a patent 26 Aug. 1791. He had built a steamboat in 1789, and by a trial of this craft, which was fitted with paddle-wheels and a crank operated by hand, was satisfied that his method of applying steam to the propulsion of vessels would work suitably. There is no evidence, however, that he succeeded in even an experimental demonstration of his plans. His model steam carriage, exhibited by him while endeavoring to obtain aid in his schemes, was never developed. He did, however, invent the vertical multi-tubular firebox boiler, which has long been in use as a standard form. Among his other inventions were several forms of pumping engines, and a plan for utilizing the force of the tide by means of reservoirs alternately so filled and emptied as to produce a continuous stream of water. Much credit belongs to Read for his early and clear perception of the importance of steam navigation. From 1800 to 1803 he was a representative in Congress, and after his removal to Maine, was for many years chief justice in the court of Hancock County. Consult: Read, 'Nathan Read' (1870); Thurston, 'A History of the Growth of the Steam Engine' (1878).

Read, Opie Percival, American journalist: and novelist: b. Nashville, Tenn., 22 Dec. 1852. He was educated in Gallatin, Tenn.; entered journalism at Franklin, Ky., and later removed to Little Rock, Ark. He edited the *Arkansas Gazette* in 1878-81; founded the 'Arkansas Traveler' in 1883, and edited it for 10 years. He has since lived in Chicago, where he has devoted himself to literary work. His publications include: 'Len Gansett' (1888); 'Up Terrapin River' (1889); 'A Kentucky Colonel' (1890); 'My Young Master' (1896); 'In the Alamo' (1900); 'Our Josephine' (1902); etc.

Read, Thomas Buchanan, American poet and painter: b. Chester County, Pa., 12 March 1822; d. New York 11 May 1872. His father was a farmer and he received but little schooling. He lived at various times during his youth and young manhood at Philadelphia, Cincinnati, New York, and Boston, occupied in ways that satisfied his tastes, such as portrait painting and writing verses, when he could; and in other ways that supplied his necessities, such as sign painting, cigar making, play acting, when he must. He published his first verses in the *Boston Courier* in 1843-4; later a Revolutionary tale 'Paul Redding' (1845) and 'Poems' (1846), before his removal to Philadelphia, where he edited 'The Female Poets of America' (1848), and brought out his 'Lays and Ballads' (1849). In 1850 he went to Europe and joined the circle of American artists living at Rome. Here he had the first opportunity for the serious study of painting, and for the rest of his life, save for occasional visits to America, he made his home at Rome. His better known paintings are 'The Water Sprite'; 'The Lost Pleiad'; 'The Star of Bethlehem'; 'Sheridan and His Horse.' He made portraits of Mrs. Browning, the ex-Queen of Naples, Henry W. Longfellow, and a group of Longfellow's children. His portrait of George Peabody is at the Institute in Baltimore. A sculptured bust of General Sheridan was executed late in life. It is as a poet, however, that he will be remembered, especially by his stirring 'Sheridan's Ride,' written for the elocutionist and actor, James E. Murdock, and the exquisitely musical lyric 'Drifting.' His volumes of verse are 'The New Pastoral' (1855); 'Sylvia or the Last Shepherd' (1857); 'The Waggoner of the Alleghanies,' in which occurs the fine lyric 'The Maid who Binds Her Warrior's Sash' (1862). A complete edition of his poems was published in 1882.

Reade, rēd, Charles, English novelist and play-writer: b. Ipsden House, Oxfordshire, 8 June 1814; d. Shepherd's Bush, London, 11 April 1884. He was educated at Oxford and was called to the bar in 1843, but, finding literature more attractive than law, devoted himself to the former, and never practised. He became first known by his novel of 'Peg Woffington' (1852), which he afterward dramatized with Tom Taylor, under the title of 'Masks and Faces.' This was followed by 'Christie Johnstone' (1853), in which he showed considerable appreciation of certain characteristics of Scottish life. The appearance, in 1856, of 'Never Too Late to Mend,' one of his "novels with a purpose," in which he attacked the English prison system with, perhaps, greater zeal than unbiased judgment, secured for him a wide reputation. His next great work, the most scholarly and artistic

of his writings, 'The Cloister and the Hearth,' dealing with the lives of the parents of Erasmus, appeared in 1861, and is decidedly his masterpiece, though it has not attained the popularity, with the general reader, of some of his more melodramatic novels. Among the more important of his other works are: 'Love Me Little, Love Me Long' (1859); 'Hard Cash' (1863); 'Griffith Gaunt' (1866); 'Foul Play' (with Dion Boucicault, 1869); 'Put Yourself in His Place' (1870); 'A Terrible Temptation' (1871); 'The Wandering Heir' (1872); 'A Perilous Secret' (1884). He was also the author, either alone or in collaboration with others, of several dramas, including 'Gold'; 'Two Loves and a Life'; 'The King's Rivals'; and 'Drink,' the last adapted from Zola's 'L'Assommoir.' None of these won much success for Reade. His 'Courier of Lyons,' renamed 'The Lyons Mail,' has been made famous by Sir Henry Irving in the dual role of Lesurques and Dubosc. Reade was enthusiastic by nature, and continually filled with new enthusiasms toward any cause which roused his easily excited interest. The abuses in the convict prison system produced, as was said, one of his best-known novels; the system of private lunatic asylums furnished the motive for 'Hard Cash,' as the trades-union outrages at Sheffield did for 'Put Yourself in His Place,' while in 'Foul Play' he attacked the alleged practice of overloading and over-insuring ships. His writings show considerable skill in the delineation of character, much narrative, descriptive, and dramatic power, combined at times with coarseness and theatricality. He may, perhaps, be said to rank first in the second order of English novelists of the 19th century, and was as popular in this country as in his own. Consult: Swinburne's article in his 'Miscellanies' (1886); 'Charles Reade: A Memoir' (1887); Ireland, 'Extracts,' with an introduction (1891); and the 'Gentleman's Magazine' for 1882.

Reade, John, Canadian Anglican clergyman and journalist: b. Ballyshannon, Ireland, 13 Nov. 1837. He was educated at Queen's College, Belfast, and in 1856 went to Canada, where he founded the Montreal 'Literary Magazine,' and was also connected with the Montreal 'Gazette.' He engaged in teaching, practised law at intervals, and in 1864 took orders in the Church of England. In 1887 he was elected president of the Montreal Society for Historical Studies. He wrote: 'The Prophecy and Other Poems' (1870); 'Language and Conquest' (1883); 'The Making of Canada' (1885); 'Vita sine Liberis' (1886); 'Aboriginal American Poetry' (1887); etc.

Reade, William Winwood, English traveler and novelist, nephew of Charles Reade (q.v.): b. Ipsden, Oxfordshire, 30 Jan. 1838; d. Wimbledon, Surrey, 24 April 1875. He visited the western coast of Africa in 1862, and in 1868 started from Sierra Leone and reached the source of the Niger. He was special correspondent for the London *Times* in the Ashantee war, 1873-4. Of his literary work perhaps his most notable effort is 'The Martyrdom of Man' (1872), a history of human slavery. His other works include 'The Veil of Isis' (1861); 'Savage Africa' (1863); 'The African Sketch Book' (1873); 'Story of the Ashantee Campaign' (1875); 'The Outcast' (1875); etc.

Read'er, Francis Smith, American journalist: b. Coal Centre, Pa., 17 Nov. 1842. He was connected with the United States Civil Service for 10 years, and served with the Union army throughout the Civil War. Later he became editor of the Beaver Valley 'News.' He published 'Life of Moody and Sankey' (1890); 'History of the 5th West Virginia Cavalry' (1890); 'History of New Brighton, Pa.' (1899).

Reader. See ORDERS, HOLY.

Reading, rēd'ing, England, capital of the county of Berkshire, 28 miles southeast of Oxford. It has handsome municipal buildings; a public hall, and free library; a museum, and excellent schools. There are remains of the magnificent Benedictine Abbey founded by Henry I., in which he was buried. Henry VIII. converted the castle into a palace; later it was destroyed during the Cromwellian wars, and the gateway alone has been restored. Other churches are St. Mary's, rebuilt from a nunnery founded by Elfrida to expiate the murder of her stepson (Edward the Martyr); St. Lawrence (Norman), rebuilt in the 15th century; St. Giles' (mixed architecture), and Greyfriars Church. Reading was the headquarters of the Danes in 871; was a refuge for the students who defied the Parliament; for the law courts obliged to leave London to escape the terrible plague, and was the fighting ground of rival armies during the conflicts of the rebellion. Reading is the centre of a large agricultural district, has an active trade and various important industrial establishments.

Reading, Mass., town in Middlesex County, on the Boston & Maine railroad, about 10 miles north of Boston. It was settled in 1638, and six years later was incorporated. It is a beautiful residential town, and has considerable manufacturing interests. The chief manufactured products are imitation leather, wire brushes, boots and shoes, rubber and rubber goods, games, church organs and organ pipes, toys, and furniture. The public library contains nearly 10,000 volumes. The government is administered by town meetings, which convene annually. Pop. (1890) 4,088; (1900) 4,969; (1910) 5,818.

Reading, Pa., city, county-seat of Berks County; on the Schuylkill River and the Schuylkill Canal, and on the Pennsylvania, the Wilmington & Northern, and the Philadelphia & Reading R.R.'s; about 58 miles northwest of Philadelphia, and 55 miles east by north of Harrisburg. Its area is about six square miles. Reading was first settled by Germans, but later a number of English colonists located there, and named the place after Reading in England. In 1748 it was laid out, and in 1783 was incorporated as a borough. It was chartered as a city in 1847. It is in an agricultural region, in which there is great mineral wealth. It has extensive manufacturing and commercial interests. East of the city is Mount Penn, and south of it is Neversink Mountain. Inclined and electric railways extend to the summit of both mountains. Mount Penn is 1,140 feet above sea-level, and on its top is a stone tower 50 feet high. The chief industries are connected with iron and steel productions, but the coal mines and limestone quarries contribute to the industrial wealth of the city. The chief industrial establishments

READJUSTERS—REAL VARIABLE

are railroad shops, machine shops, foundries, potteries, paper and wood pulp mills, breweries, knitting mills, hosiery mills, hat factories, carriage works, cigar factories, and iron and steel works. The capital invested in manufacturing in 1900 (Federal census) was \$27,975,628, and the average annual output was valued at \$36,902,511. The iron and steel industries had the largest invested capital and about one fourth of the output. There were, in 1900, over 500 manufacturing establishments, representing about 100 different industries. The principal public buildings of Reading are the government building, the county court-house, city-hall, opera house, Masonic Temple, the churches and schools. The charitable institutions are Saint Catherine's Orphan Asylum (girls), city and county orphanages, House of the Good Shepherd, Saint Joseph's, the Reading, and the Homœopathic hospitals. The educational institutions are the Schuylkill Seminary, the Inter-State Commerical College, Mount Saint Michael's Academy, Reading Classical School, Reading Academy and Business College, two high schools, a number of private schools, and two school libraries.

The city has an excellent park system covering in all nearly 200 acres. The government is vested in a mayor, who holds office three years, and a council. The members of the board of education are chosen by popular election. The annual municipal expenditures for maintenance and operation are about \$930,000; the chief items being, for schools, \$257,000; for the water department, \$234,500; for the police department, \$53,200; for municipal lighting, \$60,000; for streets, \$60,000, and for fire department, \$35,000. The waterworks cost the city originally \$1,037,762. They are owned and operated by the municipality. In 1867 and 1869 the city boundaries were enlarged. Pop. (1783), when it became a borough, 2,100; (1847), when chartered, 12,000; (1900), 78,961; (1910) 96,071.

Readjusters, or Refunders, the name of a political party in Virginia, which passed several bills providing for the scaling and partial rejection of the public debt of the State. Virginia, at the close of the Civil War, was greatly impoverished, burdened with a large indebtedness, and shorn of part of its territory, which had been erected into the State of West Virginia. The reconstruction government added considerably to the debt, and a keen controversy arose over the question of meeting the obligations. An act passed in the legislative session of 1870-71 to refund the debt was repealed, but the repeal was declared unconstitutional by the courts. In 1878 the Legislature passed a measure known as the McCulloch bill, which provided for new bonds, to be exchanged at par for outstanding bonds, and to bear interest at 3 per cent for 10 years, 4 per cent for the following 20 years, and 5 per cent for 10 years, when the principal would fall due. This act did not satisfy those opposed to payment of the debt in full, who became known as "Readjusters," and included in their ranks both Democrats and Republicans. Under the leadership of H. H. Riddleberger they succeeded in getting control of the Legislature, and passed a bill scaling the debt from \$31,102,571 to \$19,665,196. This bill was vetoed by the Governor. In 1881 the Readjusters obtained complete control of the State, and laws were enacted in accordance with their policy, the same course being pursued in 1884,

1886, and 1887. The United States Supreme Court delivered nine opinions declaring the readjustment measures, so far as they prohibited the receipt of State bond coupons for taxes, as provided by the McCulloch law, to be in conflict with the provision of the Federal Constitution, upholding the obligation of contracts. The State could not be coerced into payment, and matters remained unsettled until a compromise was agreed upon between the State and holders of the bonds.

Reagan, re'gan, John Henninger, American politician: b. Sevier County, Tenn., 8 Oct. 1818; d. Palestine, Texas, 6 Mar. 1905. At 21 he settled in Texas, where he practised law and was a member of the Texas Legislature in 1847. In 1856 he was elected judge of the district court, but resigned the next year to go to Congress, of which he remained a member until 1861. During the Civil War he served as postmaster-general of the Confederate States, and acting secretary of the Confederate Treasury. He was a member of the Texas Constitutional Convention 1875, member of the Congress 1875-97, United States Senator 1887-91, and afterward chairman of the Texas State Railroad Commission. He introduced the "Reagan Inter-State Commerce Bill," on which the present interstate commerce legislation is based.

Real, re'al, a Spanish coin, the old unit of value in Spain. By the monetary law of June 1864, the silver real was made to weigh 1.298 grams, .81 fine, and equivalent to $4\frac{1}{2}$ cents. It has varied in value from $4\frac{1}{2}$ to 10 cents.

Real Presence, the doctrine of the actual presence of the body and blood of Christ in the Eucharist. See CONSUBSTANTIATION; EUCHARIST; MASS; TRANSUBSTANTIATION.

Real Variable, Theory of Functions of the; a mathematical science. A variable is a symbol (such as x or y or "time" or "temperature") which stands for any member of a class of things. A particular member of the class is called a "value" of the variable which is said to "take on" its values. One variable, y , is said to be a single-valued function of another variable, x , if to every value of x there corresponds one and only one value of y . This is the case, for example, if x stands for any number and $y = x^2$. It is customary to express such a relation between y and x by the equation $y = f(x)$; x is called the independent and y the dependent variable. If the restriction that only one value of y shall correspond to each value of x is removed, y is called a multiple-valued function of x . Unless otherwise provided, the word function in the following pages shall mean single-valued function.

While the notions of variable and function as thus defined apply to any class of objects whatever, they are usually thought of only in connection with classes of numbers. In fact the phrase Theory of Functions is at present understood by mathematicians to mean either the theory of functions of a complex variable ($q.v.$) or the theory of functions of a real variable. In a certain abstract sense, the theory of the complex variable might be supposed to include the theory of the real variable, since all values of the real variable x_1 are included as special values ($x_2 = 0$) of the complex variable $x_1 + x_2\sqrt{-1}$. As matter of fact, however, the theory of functions of a complex variable has yet concerned itself but little ex-

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cept with analytic functions, *i.e.*, those functions which may be thought of as defined by a power-series together with its continuations. This theory therefore leaves untouched the widest class of functions of the real variable. On the other hand, since the theory of functions of a complex variable gives a broader and hence more unified theory of analytic functions than can be furnished by the real function theory, these functions are not ordinarily given special attention in the latter theory. For a discussion of algebraic functions the reader is referred to the article on Algebra; for transcendental functions, *i.e.*, functions which are not algebraic, see TRIGONOMETRY, HARMONIC ANALYSIS, DIFFERENTIAL EQUATIONS, SERIES etc.

The theory of functions of a real variable is a product of the critical tendency of mathematics in the latter half of the nineteenth century. It has yielded comparatively few new theorems about the functions hitherto studied in applied mathematics, and has therefore had less influence on these sciences than has the complex variable theory. Its main business has been the restatement in rigorous form and with proper limitation of generality, the brilliant though sometimes inexact theorems won by the earlier students of infinitesimal calculus. For example, the study of vibrating strings, membranes, etc., and of the conduction of heat led to the celebrated trigonometric series of J. B. J. Fourier (*q.v.*), which was at first incorrectly supposed to furnish a method of representing an arbitrary function. The reconsideration of this series and the attempt to determine exactly what functions are expansible by trigonometric series has led to many of the most abstruse theorems about point-sets. The theory of point-sets (Punktmengen, 'Assemblages of Points'; see article ASSEMBLAGES, GENERAL THEORY OF), it should be remarked in explanation of the proportionately large space allotted to it below, is the most characteristic feature of real function theory.

The Real Variable.—The real numbers are, first, the whole numbers positive and negative; second, the rational fractions of the form m/n where m and n are whole numbers, and, third, the irrational numbers such as $\sqrt{2}$ and π . On this subject, see the articles on Arithmetic and Algebra, and the Bibliography⁸ at the end of this sketch. (Reference numbers such as that on the word Bibliography correspond to the numbers attached to works in the Bibliography.)

The totality of real numbers is a field (Körper), *i.e.*, a set of elements upon which can be performed the operations of addition and multiplication, according to the well-known rules.⁹ We suppose also known the derived operations of subtraction, division, and raising to a power. A special symbol is used to distinguish the numerical from the algebraic value of a number: if x is positive, $|x| = x$, if x is negative, $-|x| = x$. The relation of greater and less is indicated by the symbols $<$, $>$; $a > b$ means a is greater than b , $a < b$ means a is less than b . Considerable attention has been given to the problem of stating explicitly the hypotheses of the real number system. We state here only that one the discussion of which has had the most far-reaching consequences.

Principle of Continuity.—If $[x]$ is any set of real numbers all less than a certain number, b , then there is a number, $\bar{x}$, such that every

number of $[x]$ is less than or equal to $\bar{x}$, and such that $\bar{x}$ is the smallest number of which this is true. In other words, $x \leq \bar{x}$ for every x of $[x]$, and if $a < \bar{x}$, there is a number x' of $[x]$ such that $a < x'$.

Any number, such as b in the statement above, which is larger than every number of a set $[x]$ is called an upper bound of $[x]$; a number smaller than every number of a set $[x]$ is called a lower bound of $[x]$. In this language the principle of continuity says that every set having any upper bound has a least upper bound. It follows immediately that every set having a lower bound has a greatest lower bound. The greatest lower bound or least upper bound of a set may or may not belong to the set. Thus, zero is the greatest lower bound of the set of all positive numbers but does not belong to it; on the other hand, zero is the least upper bound and does belong to the set of all real numbers which are not positive.

A very large proportion of the advances in critical sharpness of the modern analysts over those of the seventeenth and eighteenth centuries is due to the recognition of places where the earlier analysts had unconsciously assumed, or had neglected to apply, the principle of continuity. The form in which this postulate is here stated is due to K. Weierstrass^{1, 2}. Other forms have been given by R. Dedekind³ and G. Cantor⁴. Indeed, the theory of continuity and irrational numbers is due about equally to these three great Germans.

Segment, Interval, Limit Point.—By the method of analytic geometry (*q.v.*) there is a correspondence between the totality of real numbers and the points of a line; likewise between the set of all pairs of numbers (x, y) and the points of a plane, the pair (x, y) corresponding to the point of which x and y are the coordinates. On account of this correspondence, it is customary to use geometrical language in the theory of real functions; thus, the word point is used interchangeably with the word number. A linear segment is the set of all numbers x , $a < x < b$, or the set of all points between a and b ; a planar segment is the interior of a parallelogram with sides parallel to the coordinate axes, or the set of all number-pairs (x, y) , $a < x < b$, $c < y < d$. The word interval is used for a segment plus its boundaries, *i.e.*, $<$ is replaced by $\leq$ in the definition just given. A segment, linear or planar as the case may be, including a point, is called a neighborhood of the point.

Among the most important consequences of the principle of continuity is the following theorem which was first stated in a slightly different form by E. Borel¹¹ in 1895. Since its method is essentially involved in the proof of the theorem of uniform continuity (see below) given by E. Heine⁸ in 1871, it is usually called (after A. Schoenflies⁶) the Heine-Borel theorem:

Every set of segments $[o]$ such that every point of an interval, i , is an interior point of at least one σ , has a finite subset $\sigma_1, \sigma_2, \dots, \sigma_n$, such that every point of i is an interior point of at least one σ_k ($k = 1, 2, \dots, n$).¹²

We shall prove this theorem only for the linear case, the proof of the planar case being quite analogous. Let the end points of the interval i be a and b , $a < b$. Let $[b']$ be a set including every point, b' , of i such that the interval ab' is contained in a finite number of

segments of $[\sigma]$. There is at least one b' ; for one of the end points of any segment of $[\sigma]$ which includes a is evidently a point of $[b']$. By the principle of continuity, the set of all points, $[b']$, has a least upper bound B , $B \leq b$. We shall prove that B is a point of $[b']$ and that $B = b$.

Let $a''b''$, $a'' < b''$, be a segment of $[\sigma]$ including B . Since B is the least upper bound of $[b']$ there is a point of $[b']$, b_1' , between a'' and B . But if $\sigma_1, \sigma_2, \dots, \sigma_e$ is the finite set of segments including all points of the interval ab_1' , this set together with $a''b''$ will include B , which proves that B is a point of $[b']$. Moreover, if $B < b$, the set $\sigma_1, \sigma_2, \dots, \sigma_e$ together with $a''b''$ would include every point of an interval ac , c being a point between B and b'' . c would therefore be a point of $[b']$ contrary to the hypothesis that B is an upper bound of $[b']$. Hence $B = b$ and the Heine-Borel theorem is proved.

A point a in every neighborhood of which there are points, distinct from a , of a set $[x]$ is a limit point of $[x]$; a either may or may not be a point of the set $[x]$. If $[x]$ is a linear set, a is either the greatest lower bound of the numbers of $[x]$ greater than it or the least upper bound of the numbers of $[x]$ smaller than it. A linear point-set without an upper bound is said to have the limit point $+\infty$ and one without a lower bound to have the limit point $-\infty$. The following theorem of Weierstrass is a simple corollary of the Heine-Borel theorem.

"Every infinite set of points lying on an interval has at least one limit point." If it had no limit point, then about every point of i there would be a segment including not more than one point of $[x]$. This set of segments, by the Heine-Borel theorem, would have a finite subset including all the points of i . But each interval of the subset not containing more than one point of $[x]$, $[x]$ could contain at most a finite number of points, contrary to hypothesis.

If $[x]$ is a linear point-set, and if we allow $+\infty$ and $-\infty$ to figure as limit points, the theorem may, of course, be modified to read: every infinite linear point-set has at least one limit point.

Theory of Linear Point-sets.—The set of limit points of a set $[x]$ is called the first derived set of $[x]$. The first derived set of the first derived set is the second derived set, etc. The theory of successive derived sets has been highly developed by the aid of the transfinite numbers of Cantor⁴ (see ASSEMBLAGES). A set which includes its first derived set is said to be *closed* (*abgeschlossene*). A set included in its derived set is *dense in itself* (*in sich dicht*). A set which is the same as its first derived set, i.e., which is both closed and dense in itself, is said to be *perfect*. An example of a set closed but not dense in itself is furnished by the number 0,

together with the numbers $\frac{1}{2^n}$ ($n = 1, 2, 3, \dots$).

A set dense in itself but not closed is the set of all rational numbers. The set of all numbers is an example of a perfect set.

A set whose derived set is the set of all real numbers on a certain interval is *everywhere dense* (*überall dicht*) on this interval. Such a set has a point between every two points of the interval. A set which is everywhere-dense on no interval is nowhere dense. The first of the examples above is a nowhere-dense set, the second and third are everywhere-dense sets.

If $[x]$ is a closed set, nowhere dense on an interval ab , and c any point of ab not in $[x]$, then there is a segment, including c , whose end points belong to $[x]$, but which contains no point of $[x]$. Such a segment is called a *point-free segment* of $[x]$. Thus, for every closed set $[x]$ there exists one, and only one, set of point-free segments. No two of these segments overlap. Therefore they are an enumerable (or denumerable) set (see ASSEMBLAGES), namely, there can be only a

finite number of length $\geq \frac{b-a}{2}$, a finite number

of length $\geq \frac{b-a}{4}$, and in general only a finite

number of length $\geq \frac{b-a}{2^n}$. The set $[s]$ of end

points and limit points of end points of the point-free segments is evidently a closed set and is identical with $[x]$. Since the set of point-free segments is enumerable, its end points are enumerable and thus the nowhere-dense closed set is the derived set of an enumerable set of points. A consequence of this which we do not stop to prove here is that there is a one-to-one correspondence between the continuum and any perfect subset of itself; the argument depends on the theory of point-free segments and the fact that the continuum is the derived set of the enumerable set of all rational numbers.⁶

The notion, length of an interval, finds a generalization in the *content* of a point-set. $[x]$ being any set of points on an interval i , let $\sigma_1, \sigma_2, \dots, \sigma_n$ be any finite set of intervals of length $l_1, l_2, \dots, l_n$, including every point of $[x]$. Let $L = l_1 + l_2 + \dots + l_n$. There are, of course, an infinity of numbers, L . Their greatest lower bound is called the *content* of $[x]$ and written $c[x]$. If $[x]$ is a closed set and S is the sum of the finite or infinite series obtained by taking the lengths of the point-free segments in the order of their magnitude, we have $c[x] = l - S$, where l is the length of the interval i . Thus in the case of a closed set $[x]$ and its complementary set $[\bar{x}]$, which consists of all points of the interval not points of $[x]$, we have $c[x] + c[\bar{x}] = l$.⁶ This, however, is not true of sets in general. For example, the set of all rational numbers between 0 and 1 has the content unity and the set of all irrational numbers on the same interval has the same content. The notion of length is therefore extended by the definition of content, only to closed sets and not to sets in general. A much more far-reaching generalization of length has, however, been suggested by E. Borel¹¹ and carried out by H. Lebesgue¹² in connection with the theory of definite integrals (see below).

Functions Defined on an Interval.—On account of the generality of the definition, practically no theorems are known which apply to all functions on a given interval. One of the most general theorems known is obtained by introducing the restriction that on a certain interval, $f(x)$ shall have an upper bound. By this it is meant that there shall be a number, B , such that for every x on the given interval $f(x) \leq B$. From the principle of continuity it is clear that a function having an upper bound upon an interval, i , has a least upper bound B_0 , and by aid of the Heine-Borel theorem, it is easily proved that there is at least one point, x_1 , on the interval, such that for every interval of i

which includes x_1 , B_0 is the least upper bound of $f(x)$. This is a theorem of Weierstrass.¹

Another broad class of functions is that of the monotonic functions.¹ A function, $f(x)$, is monotonic increasing if whenever $x_1 < x_2$, $f(x_1) < f(x_2)$; it is monotonic decreasing if whenever $x_1 < x_2$, $f(x_1) > f(x_2)$. In the case of a monotonic function, $f(x)$, not only is there a single value of $y = f(x)$ for every value of x , but for every value of y taken on by $f(x)$ there is one and only one value of x . In this case it is the custom to write $x = f^{-1}(y)$ and to call $f^{-1}(y)$ the inverse function of $f(x)$. Thus every monotonic function, $f(x)$, has a single valued inverse which, however, is not necessarily defined for all values of y .

In antithesis to the monotonic functions stand oscillating functions, those such that on the interval under consideration there are three values of the independent variable, x_1, x_2, x_3 , $x_1 < x_2, x_2 < x_3$, such that $f(x_1) < f(x_2), f(x_2) > f(x_3)$, or $f(x_1) > f(x_2), f(x_2) < f(x_3)$. There exist functions which oscillate on every interval; indeed, a function may oscillate on every interval and still be continuous and have a continuous derivative.⁶ The definition of continuity is given below and of derivation in the article CALCULUS. In most investigations hitherto the functions considered have had only a finite number of oscillations; i.e., there would exist a finite set of points such that on the intervals between successive points the function would not oscillate. It is to be noted that a non-oscillating function is not necessarily monotonic; there may be intervals upon which it is a constant.

The word oscillation is also used to denote a measure of the total amount of variation of a function on a given interval, that is, the difference between the upper and lower bounds of $f(x)$. This is a satisfactory measure in case $f(x)$ is monotonic. In other cases, especially in case of functions with oscillation on every interval, this scheme is naturally extended as follows: Let $x_1, x_2, x_3, \dots, x_{n-1}$ be any finite set of points on the interval ab in the order $a < x_1 < x_2 < x_3 \dots < x_{n-1} < b$. Calling $a = x_0$ and $b = x_n$, we have $\sum_{k=1}^n (f(x_k) - f(x_{k-1})) = f(b) - f(a)$.

But $\sum_{k=1}^n |f(x_k) - f(x_{k-1})| = R$ is, except for non-oscillating functions, different from $f(b) - f(a)$. For every finite set of points $x_1, x_2, \dots, x_{n-1}$, there is a value of R . The least upper bound, V , of the set of all possible numbers, R , is called the variation of $f(x)$ on the interval ab . A function for which V is finite is called a function of limited variation; such a function can always be expressed as the difference between two monotonic functions. Functions of limited variation were first defined and studied by C. Jordan in connection with the theory of lengths of curves.

Theory of Limits. — Turning from the description of a function by its properties on an interval to a consideration of its appearance in the immediate neighborhood of a point, we are led to consider the notions of limits and of continuity. If a is a limit point of a set of points $[x]$, then the variable x is said to approach a on the set $[x]$. In case all the values of x are $\geq a$, the approach is said to be from above, and in the opposite case, from below. Let $f(x)$ be a function which is defined and bounded on an interval ab , $a < b$, and let $x_1, x_2, \dots$ be any set of points of ab of which a is the only limit point. Such a set is, for example,

$$a + \frac{b-a}{2}, \quad a + \frac{b-a}{4}, \dots, a + \frac{b-a}{n}, \dots$$

The points whose coordinates are $(x_1, f(x_1)), (x_2, f(x_2)), \dots$, in the graphical representation of $f(x)$ are a bounded set in the plane, and therefore have at least one limit point. The x coordinate of this point cannot be other than a , since every other x coordinate may be surrounded by a segment including at most one point of the set, $x_1, x_2, \dots$. Call the y coordinate of this point, y_0 . The value y_0 is such that for every pair of positive numbers, ϵ and δ , there is a value of $x > a$, such that $|x - a| < \delta$ and $|f(x) - y_0| < \epsilon$. A number, y_0 , satisfying this condition is called a value approached by $f(x)$ as x approaches a from above. If in every interval $a\bar{x}$ of ab , $f(x)$ is without an upper bound, $f(x)$ is said to approach the value $+\infty$ as x approaches a from above; if $f(x)$ is without a lower bound in every interval $a\bar{x}$, $f(x)$ approaches $-\infty$. Thus we have the highly important theorem that as x approaches any finite value from above (and by parity of reasoning, from below) $f(x)$ approaches at least one value, finite or infinite.

A finite value approached by $f(x)$ as x approaches $+\infty$ is a number, y_0 , such that for every pair of positive numbers, ϵ and δ , there is a value of x such that $x > \delta$ and $|f(x) - y_0| < \epsilon$. $f(x)$ approaches $+\infty$ as x approaches $+\infty$ if, for every ϵ and δ , there is a value of x such that $x > \delta$ and $f(x) > \epsilon$. The definition of approach to $-\infty$ is analogous. In the case where x approaches a finite value, x_0 , from above or below or from both sides, $f(x)$ approaches y_0 if for every pair of positive numbers, ϵ and δ , there is a value of x ($x \neq x_0$), such that $|x - x_0| < \delta$ and $|f(x) - y_0| < \epsilon$. The theorem of the last paragraph now extends to all cases: if x approaches any value finite or infinite, $f(x)$ approaches at least one value, finite or infinite.

If $f(x)$ approaches only one value as x approaches a , the value approached is said to be the limit of $f(x)$ (or limiting value of $f(x)$) as x approaches a , and is indicated by the symbol L $f(x)$ or simply $Lf(x)$. If $Lf(x) = f(a)$ the

function $f(x)$ is said to be continuous at the point $x = a$. A necessary and sufficient condition for the existence of the equality $Lf(x) = f(a)$ is the following: for every $\epsilon > 0$ there exists a $\delta_\epsilon > 0$, such that for every $x \pm a$ for which $|x - a| < \delta_\epsilon$, $|f(x) - f(a)| < \epsilon$. This condition, which is frequently taken as the definition of a limit,^{5,7} has to be appropriately modified in the cases where a and b are replaced by $+\infty$ or $-\infty$. The following is a necessary and sufficient condition that $Lf(x)$ shall exist and be finite:^{1,8} for every $\epsilon > 0$ there exists a $\delta_\epsilon > 0$, such that for x' and x'' distinct from a and such that $|x' - a| < \delta_\epsilon$ and $|x'' - a| < \delta_\epsilon$, $|f(x') - f(x'')| < \epsilon$.

The proof of these necessary and sufficient conditions and also of the following theorems must be omitted for lack of space. If $f_1(x)$ and $f_2(x)$ approach definite limiting values as x approaches a , then $f_1(x) + f_2(x)$, $f_1(x) - f_2(x)$, and $f_1(x) \cdot f_2(x)$ approach $Lf_1(x) + Lf_2(x)$, $Lf_1(x) - Lf_2(x)$, and $Lf_1(x) \cdot Lf_2(x)$ respectively, as x approaches a ; if $Lf_2(x) \neq 0$, then $f_1(x)/f_2(x)$ approaches $Lf_1(x)/Lf_2(x)$. These propositions are evidently

to be thought of also as propositions about continuous functions. To them should be added the statement that if $f_1(x)$ is continuous at $x=a$ and $f_2(y)$ is continuous at $y=f_1(a)$, then $f_2(f_1(x))$ is continuous at $x=a$. Also, if $f(x)$ is continuous at a point $x=a$, and if $f(a)$ is positive, then there is a neighborhood of $x=a$ upon which the function is positive.¹

In the above propositions about limits it is not necessary that $f(x)$ be defined at every point of an interval. Everything we have said about $Lf(x)$ remains valid when x takes values on any set of which a is a limit point. Indeed, in one of the most important cases, that of the summation of series (q.v.) the independent variable takes on only integral values, and $a=+\infty$. For the following theorems, however, we assume that $f(x)$ is defined at every point of an interval.

Continuous Functions.— $f(x)$ is continuous on an interval ab if it is continuous at every point of the interval; in particular, it must be continuous at a and b . One of the most famous propositions of real function theory states the principle of uniform continuity:² if ϵ is any positive number, there is $\delta>0$, such that on every interval of ab of length less than δ , the oscillation of $f(x)$ is less than ϵ . Other propositions in this connection are that a continuous function has a finite maximum value $f(x_1)$ and a finite minimum value $f(x_2)$ and takes on all intermediate values.³ An important corollary of this is that every algebraic equation of odd degree with real coefficients has one real root. If a function is monotonic and continuous, it has a monotonic and continuous inverse.

If $f_1(x)$ and $f_2(x)$ are continuous on an interval ab and if $f_1(x)=f_2(x)$ on a set everywhere dense on ab , then $f_1(x)=f_2(x)$ at every point of the interval ab . The last theorem enables us to say that if a continuous function is known at every point of an everywhere dense subset of an interval, it is known on the whole interval. Since there are enumerable everywhere dense subsets, a continuous function is thus capable of determination by an enumerable set of conditions. This phenomenon is also manifested in the theorem that any continuous function may be expressed as a convergent series of polynomials. Generalizations of this theorem to discontinuous functions have been obtained by R. Baire,⁴ the next class of functions beyond the continuous being those discontinuous functions which are representable by series of continuous functions.

The class of continuous functions includes as a subclass the differentiable functions, i.e., those continuous functions which possess at every point a derivative (see CALCULUS). The existence of a derivative, which amounts to the condition that the graph of $f(x)$ shall possess a tangent, puts a limitation on the manner in which a function may oscillate.⁵ The earlier students of calculus assumed that every continuous function may be differentiated, in fact, several proofs of this statement were offered. Weierstrass⁶ was the first to give an example of a function which is everywhere continuous and such that for no interval is it differentiable at every point.

A subclass of the differentiable functions is constituted by those functions for which the second, third, and in general the n th derivatives exist. For such a function a formal expansion by means of Taylor's formula (cf. SERIES, CALCULUS) is always possible, but as has been

shown by A. Cauchy and A. Pringsheim,⁷ this series need not always converge and, if convergent, need not represent the function. A function which may be represented by Taylor's series is called analytic. Necessary and sufficient conditions for the expansibility of functions by Taylor's series have been given by Pringsheim, but the full significance of the existence of all the derivatives of a continuous function is still to be determined.

Another outstanding problem in connection with continuous functions is that of the orders of infinities and infinitesimals. A function $f(x)$ becomes infinite or infinitesimal at a point if it approaches $+\infty$, $-\infty$, or 0 . If $f(x)$ and $\phi(x)$ both become infinite (or infinitesimal) at the same point, a , we may have their quotient approaching (1) more than one limit, (2) a unique finite limit, not zero, (3) zero, (4) $+\infty$. For the first case no extensive theory has been developed. In the second case the functions are said to be of the same order; in the third case $f(x)$ has an infinity of lower order or is infinitesimal of higher order than $\phi(x)$; in the fourth case $f(x)$ has an infinity of higher order or is infinitesimal of lower order than $\phi(x)$. For analytic functions the notion of order is well established, for other functions not.

Discontinuous Functions.—A function may fail to be continuous at a point in several ways. In the first case, $Lf(x)$ may exist but be different from $f(a)$. In this case the discontinuity is called removable (*hebbare*), because by modifying the value of $f(a)$ to be the same as $Lf(x)$ a continuous function is obtained. If $Lf(x)$ fails to exist, $f(x)$ may still approach definite limits from above and from below. These limits are usually indicated by $f(a+0)$ and $f(a-0)$. $f(a)$ may coincide with either of them or differ from both. All these cases are referred to as discontinuities of the first kind.¹ If $f(a+0)$ or $f(a-0)$ fails to exist, that is, if $f(x)$ approaches more than one value as x approaches a from the right or from the left, $f(x)$ is said to have a discontinuity of the second kind at $x=a$. For this to occur, $f(x)$ must have an infinity of oscillations in every neighborhood of $x=a$. Such a function is $\sin\left(\frac{1}{x}\right)$ in the neighborhood of $x=0$.

It is easily provable that there is a finite or infinite greatest value approached by $f(x)$ on either side of $x=a$ and likewise a finite or infinite least value approached. These four numbers are generally denoted by $\overline{f}(a+0)$, $\overline{f}(a-0)$, $\underline{f}(a+0)$, $\underline{f}(a-0)$. The differences among these four numbers and $f(a)$ give a variety of ways of defining a measure of the amount of discontinuity at a point. For example, the lower bound of the oscillation of $f(x)$ on every interval which includes $x=a$ is the difference between the greatest and the least of these five numbers and is called the oscillation of $f(x)$ at $x=a$.

In classifying discontinuous functions according to the distribution of the points of discontinuity over an interval there are two cases of which other cases are compounds. On the one hand, are the totally discontinuous functions, i.e., functions discontinuous at every point, such, for example, as the function which is $+1$ if x is a rational number and -1 if x is an irrational number. On the other hand, every interval may contain a point where $f(x)$ is con-

annous; such a function is called point-wise discontinuous, though there is some divergence of usage in this particular.¹ A point-wise discontinuous function has the property that the points where the oscillation is greater than any fixed positive number, ϵ , constitute a nowhere-dense closed set. On considering an infinite

sequence, $\epsilon, \frac{\epsilon}{2}, \frac{\epsilon}{4}, \dots$ of such numbers, it is

evident that the set of points of discontinuity of a point-wise discontinuous function is an enumerable set of nowhere-dense closed sets.

The theory of discontinuous functions has received perhaps its main impetus from the study of definite integrals (see CALCULUS). It is easily seen by aid of the principle of uniform continuity that every continuous function is integrable and it is also evident that a totally discontinuous function is not integrable. Riemann proved that a necessary and sufficient condition for the integrability of a discontinuous function is that the set of points at which the oscillation of $f(x)$ is greater than any positive number shall be of content zero.² Thus an integrable function is continuous or so point-wise discontinuous that the set of points of discontinuity is an enumerable set of sets of content zero.

The content of a point-set is the definite integral of a function which is equal to unity for all points of the set and to zero for all other points. Corresponding to the Borel-Lebesgue generalization of content is a generalization of the definite integral, due to Lebesgue,³ which extends the notion to a very broad class of functions. This generalization has been guided largely by the aim to state the definitions of differentiation and integration in such a way that they shall be inverse operations. According to the usual definitions (see CALCULUS) this is true for a limited class of functions, but there exist, on the one hand, functions whose integrals cannot be differentiated, and, on the other hand, functions whose derivatives cannot be integrated. The only effective generalization of the derivative that has been suggested in this connection is the substitution for the regular limit of $[f(x) - f(x_1)]/[x - x_1]$, one of the upper and lower bounds of the values approached by it as x approaches x_1 from above or below.

Attempts to generalize the limiting process in various directions are characteristic of the present tendencies in analysis. The principal results so far have been obtained in connection with infinite divergent series by Cesaro, Mittag-Leffler, Borel,⁴ and others. Another class of problems is the solution of functional equations. For example, it is known that among continuous functions, if $f(x+y) = f(x) + f(y)$, then $f(x) = ax + b$. But is this true if the restriction of continuity be removed?

Functions of More than One Variable.—The above account has dealt entirely with functions of one variable. A single-valued function of several variables, $f(x_1, x_2, \dots, x_n)$ is a variable y such that to every set of values $(x_1, x_2, \dots, x_n)$ there corresponds one, and only one, value of y . The theory of such functions differs from that which we have been considering mainly in that the point-sets involved are no longer linear, but, rather, n dimensional. The approach to a point in a limiting process may now take place not only from two sides but by an infinity of paths. In grasping this situation, the principal idea so far advanced is that of uniform convergence

(cf. SERIES). But on this subject the reader is referred to the treatises cited below.

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Realf, rälf, Richard, Anglo-American poet: b. Framfield, Sussex, 14 June 1834; d. Oakland, Cal., 28 Oct. 1878. He published a volume of verse, 'Guesses at the Beautiful,' when 18; came to the United States in 1854, settling in Kansas, and, becoming a follower of John Brown, enlisted in the Union army in 1862, and wrote some of his best poetry in the field. Among his best-known poems are 'My Slain' and 'Indirection.' A collection of his poems was edited by R. J. Hinton (1899).

Realgar, a gorgeous, aurora-red mineral, found massive and in transparent or translucent, monoclinic crystals of short prismatic habit. Its lustre is resinous, hardness 1.5 to 2; streak orange-red. Analysis shows that it contains sulphur 29.9, arsenic 70.1, yielding the formula AsS or arsenic monosulphide, though it is usually regarded as arsenic disulphide, As₂S₂. Upon exposure to light it soon disintegrates, changing to a pulverulent, orange-yellow orpiment (As₂S₃) and white arsenolite (As₂O₃). Several localities in Hungary and neighboring countries are of commercial as well as mineralogical importance. It has recently been discovered in Macedonia, in Mercur in Utah, and massive, in enormous deposits, in the State of Washington. Its previous rarity precluded its use in the manufacture of **ar**

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senious oxide, for which purpose it is now extensively mined in Washington. Artificial realgar, known as "red orpiment" or "ruby sulphur," when mixed with nitre forms "white Indian fire."

Realism. (1) a term used in two fundamentally different senses in the history of philosophy. (a) During the period of Scholasticism (q.v.), realism denotes the doctrine that universals have in some sense an existence which is independent of the particular things that appear to the senses. This theory is derived from Plato's doctrine of ideas, and goes back ultimately to the Socratic view that only through the concept, or universal idea, is it possible to obtain real knowledge. Plato, developing this position, maintained that the universals, as ideas, exist apart from the world of sensible appearances, and form the true and abiding reality, while the latter is merely the world of imperfect copies, the transitory and inadequate representations of this true world of supersensible existence. In spite of the differences in name, then, and the necessary difference of interest in the problem due to the special intellectual outlook of the times, mediæval realism in its earlier and extreme form is identical in standpoint with Platonic Idealism. The later mediæval realists, under the criticism of nominalism (q.v.), modified the extreme view that universals exist apart from things, in the same direction in which Aristotle modified Plato's doctrine of the separate existence of ideas. That is, instead of defending the extreme proposition that universals exist prior to and independent of things (*universalia ante rem*), they maintained with Aristotle that it is the universal, the type or form, that constitutes the particular an individual thing, and that the two are therefore always found together (*universalia in rebus*). The whole problem of the relation of the universal and the particular, as it presented itself to the Scholastic mind, received its most adequate statement and solution at the hands of Thomas Aquinas. He pointed out that there is a sense in which all of the formulas that had been proposed by realists and nominalists alike are true and justifiable. We may say that the universal is prior to the thing and independent of it, inasmuch as we must suppose that the idea as a universal, existed in the mind of God before particular things were created; and in this sense we may therefore accept the statement *universalia ante rem*. But it is the presence of universals that gives to particulars their reality, and it is through their presence in things that they are known to us; therefore the formula *universalia in rebus* is justified. Furthermore, it is the particular, not the universal, that is first known to us. So that from the standpoint of our knowledge, we may admit the nominalistic proposition *universalia post rem*.

(b) In modern philosophy, realism has an entirely different meaning, and is directly opposed to idealism (q.v.). Realism in modern systems assumes many forms, just as idealism does, and the two views approximate to each other in so-called doctrines of ideal-realism. But yet the fundamental distinction between these two types of thought remains, and may be definitely stated as follows. Realism maintains that the universe is composed of a larger or smaller number of

"reals" that exist in and for themselves, independently of any relation to mind. Its main historical contention has been in opposition to any theory that would reduce the world to a system of ideas. Usually the argument of the realists has been directed against the type of idealism that attempts to interpret reality in terms of the consciousness of finite individuals. But it also maintains that real things possess a being outside and in a real sense independent of the absolute experience of God. We may grant, the realist would argue, that God knows all things, yet these things are not merely his ideas, but possess a reality and independence of their own. These real things are variously conceived in the different systems. In the Scottish Philosophy (founded by Thomas Reid 1710-96), we have the doctrine of "Natural Realism." That is, things are regarded as real just as they are given through immediate perception. In knowing, the mind deals directly with independent real things. This reality is guaranteed by "Common Sense," or the fundamental intuitions of mankind. By Kant, on the contrary, the world of perceptive experience is regarded as merely a phenomenon of consciousness. There remains for Kant, however, a world of things-in-themselves beyond experience which can never be known, but which we are necessarily obliged to think as the basis of the phenomenal world. As completely unknown and unknowable, this world of ultimate reality is incapable of any description or theoretical treatment whatever. Herbert Spencer, who speaks of his view as "Transfigured Realism," occupies fundamentally the same position as Kant. Herbart (1776-1841), while agreeing with Kant that the world of sense experience is phenomenal and exists only for a knowing consciousness, still holds that it is possible to define and determine by means of metaphysical investigation the nature of reality in itself. He therefore postulates the existence of a plurality of absolute "Reals" (*Reale*), each of which is simple and unchangeable, and between which relations obtain which give rise to the phenomenal order of experience. Leibnitz (1646-1715) in his doctrine of Monads, Fechner (1801-87), and Lotze (1817-81), regard the ultimate of nature of reality to be a system of psychical forms of existence or souls.

(2) In the Fine Arts and in Literature, Realism is opposed to Idealism. In general, it may be said that realism insists on correspondence with nature, on representing things as they are actually found in experience, while idealism tends toward an imaginative treatment which does not limit itself to reality as actually known. These two methods of treatment can never be absolutely exclusive of each other. In the work of any given individual one element or the other may be most prominent, but both must be present if the picture or statue or writing is to rank as an artistic production. Both in the choice of subject and in the details of his treatment the realistic artist idealizes: that is, he interprets the actual by isolating it from the context or environment in which it appears, and which serves to some extent to hide its true significance, and secondly, he also idealizes by representing in his treatment what is universal and essential, omitting certain things and selecting others with this end in view. On the other hand, the idealist who

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"bodies forth the forms of things unseen," or sings of "a light that never was on sea or land," must nevertheless be "true to nature," in the sense that his imagination must work in accordance with the laws of reality. Otherwise the result is something grotesque and fantastic. We do, however, speak of the work of any particular individual as realistic or idealistic according as the treatment shows more prominently one tendency or the other. There are three ways in which these different tendencies, or attitudes of mind, are shown in the fine arts and literature. In the choice of a subject matter, the realist selects either something actually existing, some familiar scene, or well known event, or at least, if he does not make an exact transcript of a particular object or set of occurrences, it is the concrete individual things of experience with which he deals. Idealism, aiming more directly at the representation of what is universal and typical, constructs for itself its forms and matter, choosing to express itself through a representation it may be, of angels, Graces, or Madonnas, or through a literary portrayal of events and occurrences of some past time that admits of free imaginative treatment. This difference in choice of subject matter also carries with it important variations in manner of portrayal. As realism aims more directly than idealism at correspondence with nature, it is clear that it must emphasize to a greater extent fulness and accuracy of detail. But there is also a difference in the kind of detail that is chosen, and in the emphasis that is given to details of different characters. As it is the object of realism to represent its subject matter in concrete, individual form, the details which are essential to produce this impression are naturally emphasized. An idealistic treatment, on the other hand, seeking to represent more directly the universal and essential, necessarily gives an entirely different value to the various details, omitting, it may be, much that would be regarded as essential in the school of realism, and giving a prominent place to what the latter might keep in the background. It is false art and a false realism, however, that emphasizes what is ugly, unpleasant, and pathological in such a way as to make these the most prominent features of the total work. This *réalisme* has rightly been held to be characteristic of a decadent art, of an art that is inevitably suicidal. For the real, which it is the business of art to reveal and portray, in nature and in human nature alike, is the universal, the abiding, and hence the normal; for what is diseased and monstrous are necessarily particular and transient. Art, like all conscious activity, can only live so long as it assumes that what is rational in the fullest sense must be real.

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Realschulen, rā-āl'shoo-lēn, a class of institutions in the German system of secondary education characterized by the emphasis laid upon the study of the sciences, mathematics, and modern languages as opposed to the gymnasias in which the classics constitute the principal feature of the curriculum. The Realschule took its rise in Germany in the early part of the 18th century, but did not attain its full development until the second half of the 19th century, when the tremendous progress of science compelled, after a long struggle, the recognition of this type of school as of equal rank with the gymnasias in the national system of education. In the struggle, however, between the classical school and the scientific school a mixed form was developed, approaching more nearly to the Realschule in the importance attached to the non-humanistic branches, but including Latin in its lists of studies. This type of school is known as the Real-gymnasium, and between it and the gymnasium the differences are growing less every year, especially since the study of Greek in the Prussian gymnasias was rendered non-obligatory in 1900. Real-gymnasias are, however, included under the general designation of Realschulen, a term which, in its broadest signification, includes the following classes: (1) *Oberrealschulen* (Upper Real Schools), scientific schools with a nine years' course, giving no instruction in the ancient languages; (2) *Realgymnasien* (Real-gymnasias), scientific schools with a nine years' course, giving instruction in Latin; (3) *Realschulen* (in a stricter sense), the same as the *Oberrealschulen*, without the highest class, giving thus a seven years' course; (4) *Realprogymnasien*, bearing the same relation to the *Realgymnasien* as the *Realschulen* to the *Oberrealschulen*; and (5) *Höhere Bürgerschulen* (higher middle schools), offering a six years' course without Latin. While the Real-gymnasium has been approaching the classical schools in character, the Real-schools proper have been extending their scope so as to include various forms of technical and even industrial education. Graduates of Real-schools are ineligible for admission to various departments and faculties in the universities, the most liberal conditions prevailing in Prussia, where only the faculty of theology is closed to them.

Realty and the terms *real property* and *real estate* denote the interest one has in lands; it applies not only to ground but to everything which is attached or a part of it, as trees, stones, houses, or other structures. Timber, grain, and grass rooted to the soil are realty, though when severed they become personalty. Any crop which is an annual product of the soil when ripe is considered as personal property. Permanent buildings erected on one's land without permission become the property of the owner of such land, without regard to the ownership of the materials. Fixtures or things which have been attached to the realty and can-

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not be removed without injury to it, or which have become so adapted to the building or land as to be necessary to its use, are considered a part of the realty. In addition to the elements of realty which have been above described, are rights which are connected therewith, such for example, as a right of way, a right to the use of water course and easements. An uninterrupted use of any easement or right for 20 years, or any less period fixed by statute raises presumption of title. The various estates which one may possess in realty had their origin in the feudal system of England, the fundamental principle of which is that the king was the original proprietor of all the land in his kingdom, and no one came into any part of it except by gift from him, or in return for feudal services, and thus the land was divided among a graded body of owners beginning with the king's noblemen. In the United States all the instances of feudal tenure have been abolished. In Canada the tenure by which land is held varies in the different provinces, some being largely regulated by a statute enacted during the reign of George III.

Title has been defined as a means whereby the owner of lands has the just possession of his property; title may be acquired by descent, that is, through the death of an ancestor, by purchase, or by operation of law. The legal title of land is usually transferred from one person to another by means of a deed, the many essentials of which are fixed by the statutes in various jurisdictions.

Ream's Station, Battle of. As the extension of Gen. Grant's left to Globe Tavern on the Weldon Railroad (see **GLOBE TAVERN, BATTLE OF**) did not prevent Gen. Lee's use of the road as a line of supply up to a point within a day's wagoning to Petersburg, Gen. Grant determined to destroy the road as far down as Rowanty Creek, 13 miles beyond Globe Tavern. On 22 Aug. 1864 Gen. Hancock, with Miles' and Gibbon's divisions of the Second Corps and Gen. Gregg's cavalry division, in all about 8,500 men, moved to the left, and by night of the 24th had destroyed the road from Globe Tavern to a point three miles south of Ream's Station, and 12 miles from Petersburg. During the 24th Gregg's cavalry was sharply attacked by Gen. Butler's division of Confederate cavalry, and at night Gen. Meade informed Hancock that Confederate infantry was moving in his direction, but as yet none had been seen by Hancock. At daylight of the 25th a cavalry reconnoissance drove in the Confederate pickets, and Gibbon was ordered to move out from Ream's Station and complete the destruction of the road. Gibbon had hardly gotten well on the road, when the Union cavalry was driven in by cavalry supported by infantry, and he was obliged to deploy a strong skirmish line to check the enemy in pursuit. Prisoners taken from three of Gen. A. P. Hill's divisions showed that the Confederates were in strong force and Gibbon was ordered back to the Ream's Station intrenchments, where he arrived at 10 A.M. and united with Miles' division. The intrenchments were very light and had been hurriedly thrown up by Gen. James H. Wilson in his cavalry fight near that place late in the preceding June. They ran along the railroad about 700 yards and then

were drawn back on the right and left about 800 or 900 yards, at nearly right angles. Both flanks were exposed to reverse fire from the front. Miles held the right half of these works, Gibbon the left half. Gregg's cavalry held the approaches in the direction of Petersburg and Dinwiddie Court House. When Hancock's movement became known to the Confederates Gen. A. P. Hill, with the larger part of his corps, together with G. T. Anderson's brigade of Longstreet's corps and Gen. Wade Hampton's two cavalry divisions, marched to prevent the destruction of the railroad, and at 2 P.M. of the 25th Gen. Wilcox's division made two attacks upon Miles, which were repulsed, leaving killed and wounded within a few yards of Miles' front. At 5 P.M. Hill opened a heavy artillery fire and, at the end of 15 minutes, Gens. Heth and Wilcox, with five brigades and three regiments, made another assault upon Miles, and a part of his line, held by raw recruits, gave way, abandoning a battery. At the same time the right of Gibbon's line gave way and two more batteries fell into possession of the Confederates. Gibbon was ordered to retake his lost ground, but his troops, many of whom were new recruits and drafted men, responded feebly and fell back under the first fire. Miles rallied the 61st New York, and by desperate fighting retook a part of his line and his lost battery. Hampton's cavalry now attacked Gibbon and drove him entirely from his works, but was checked by a heavy flank fire from Gregg's dismounted cavalry, upon which Hampton turned on Gregg and forced him back to the left of a line which Gibbon had established a short distance in rear of the intrenchments from which he had been driven. An effort made to retake the intrenchments failed because of the inability of the Union commanders to induce their men to go forward. At dark Hancock withdrew from the field. Gen. Hill made no attempt to follow up his advantage, but returned to the Petersburg intrenchments, leaving Hampton's cavalry at Ream's Station. The Union loss was 669 killed and wounded, and 2,073 captured or missing, together with 12 stands of colors and nine guns. The Confederate loss, as reported by Hill, was 720, chiefly, if not entirely, killed and wounded. Consult: 'Official Records,' Vol. XLII.; Humphreys, 'The Virginia Campaign of 1864-5'; Walker, 'History of the Second Army Corps'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV. E. A. CARMAN.

Reapers and Reaping. See **AMERICAN FARM IMPLEMENTS**.

Rear-horse. See **MANTIS**.

Rearick, Peter Anton, American naval officer: b. Maryland, 12 Nov. 1838; d. Washington, D. C., 9 Feb. 1901. He entered the navy in 1860, was appointed third assistant engineer, and served through the Civil War with promotion, becoming first assistant engineer in 1864. In 1874 he was made chief engineer and served in that capacity until 1900, when he was retired with rank of rear-admiral.

Reasoning, or Inference, is a mental process in which we advance from some known facts to the truth of some other fact which is different from the starting-point. The basis for the transition is always found in the knowledge from which we set out: this is taken or as-

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sumed to be real, and in it is found the ground and justification for the advance to something else. The differentia of reasoning thus appears to be mediation; when we reason we infer that something is true because something else is true. Knowledge derived from reasoning may therefore be termed mediate, as opposed to the immediate knowledge obtained from sense perception and memory. The question at once arises how any mental content can justify an advance to something different from itself? How are we ever warranted in passing from the known to the unknown? This is not merely the question that Mill raised as to whether all syllogistic reasoning—all advance from premises to conclusion—was not a *petitio principii*; but it concerns all reasoning, inductive and deductive alike. The dilemma is that if the result is not contained in the starting-point the advance does not seem to be justified; if it is already present, the reasoning shows nothing new. The view of Leibnitz was that all reasoning is analysis, a drawing out and fuller explication of the original datum of the mind. Kant pointed out that thinking involves also synthesis, new constructions and additions to the material from which it starts, and he takes as the fundamental problem of his 'Critique of Pure Reason' the question, how such synthetic judgments are possible. His answer is essentially identical with that which Aristotle gave, namely, that the mind or reason (*νοῦς*) itself enters into the process as a premise—or, in other words, that it is through the creative activity of the mind that the new truth is reached. Whether or not one can connect one fact with another in a logical way depends upon one's intellectual ability to discover points of essential resemblance or identity between facts. The good reasoner is he who can look beneath the surface and detect identities that are not at once obvious, as Newton, for example, did when he reasoned from the fall of the apple to the movements of the heavenly bodies. Reasoning, then, may be defined as the process of discovering essential resemblances or points of identity between things.

It follows from what has been said that reasoning is not a process or function of mind that can go on apart from experience. The thinkers of the modern period down almost to the end of the 18th century, continued to believe that reason was a kind of special organ or faculty that could yield truth of the highest order of certainty quite apart from ordinary experience. It was Kant who first clearly and incontestably showed the impossibility of deriving knowledge from reason taken in abstraction from ordinary sense experience. Kant, however, uses the term Understanding (*Verstand*) for the thinking faculties as employed in interpreting experience, and reserves the name Reason (*Vernunft*) for the vain and illusory attempt of thought to operate in independence of any given material of experience. Apart from this terminology, however, which has not been generally followed, the result of Kant's teaching was to exhibit the close and essential connection that exists between thinking and sense-perception: on the one hand, thought is empty apart from the material of sense-perception, and, on the other, what we call ordinary perceptive experience is constantly interwoven with more or

less explicit processes of reasoning. Reasoning does not go on in a vacuum, nor is it a separate and distinct function of mind that in some mysterious way spins truth out of itself. But reason is on one side a universal function of receptivity; it receives its material from every channel of experience, and is itself just the unifying, co-ordinating, and systematizing life of experience. Deduction and induction are often spoken of as if they were distinct species of reasoning. Reasoning, however, is always one and the same process. It consists, as we have seen, in connecting parts of experience by the discovery of some identical element in them. This identity, as present in various particulars, we may speak of as a universal, or general principle, and therefore say that when we reason we unite particulars through a general law or principle. Now, the difference between deduction and induction is a difference in the starting-point and in the direction in which we proceed. If we are already in possession of the general law, and set out to apply it to particular cases, we are using deduction. If, however, our starting-point is the particular instances, then we reason inductively to discover the universal law of connection. In both cases the structure of the completed inference is the same, and consists in the connection of particulars, in virtue of our insight into the universal law or principle expressed in them.

In this reference to a universal principle, we have also that which distinguishes reasoning from the transition from idea to idea of the associative process. In a large part of the conscious life which usually is described as thinking, one idea by its very presence seems to call up another, without the apprehension of any universal or essential law of connection. But this is mere drifting on the part of the mind. In reasoning the mind is fully awake; it sets a definite purpose before it, and proceeds by active attention and analysis to discover essential and necessary points of connection. It thus uses association for its own purposes; so that if we define reasoning as a process of association, we must add that it is association guided and controlled at every step by the purposes of thought itself. How conscious and explicit must this direction be before we can call the process reasoning? Can animals properly be said to reason? These questions do not admit of any off-hand answer. The conscious direction of the mind, the clearness with which it apprehends the universal in the particular, is a matter of degree. We may say that some direction on the part of the mind then must be, as well as some apprehension of the terms as universal, if reasoning is to occur, without attempting to determine just when these conditions are fulfilled in any individual mind or in any species. What we call conscious reasoning, is doubtless continuous with associative and instinctive mental processes that seem entirely mechanical and irrational, and the connection between the two extremes may be mediated by actually observable processes. This continuity, however, gives no justification for refusing to regard the differences as important, or for explaining either extreme of the process in terms of the other. See DEDUCTION; INDUCTION; LOGIC.

Consult: Bosanquet, 'Logic,' Vol. II. (1888); James, 'The Principles of Psychology,'

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chap. xxii. (1890); Creighton, 'An Introductory Logic,' Part III. (1898); Stout, 'Analytic Psychology' (1896); see also the bibliography under LOGIC.

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Réaumur, rā-ô-mür, **René Antoine Ferchault de**, French physicist: b. La Rochelle 28 Feb. 1683; d. La Bermondiere, Maine, 17 Oct. 1757. He studied under the Jesuits at Poitiers, and afterward at Bourges, and went to Paris in 1703. His relative, the president Hénault, introduced him to the savants of the metropolis, and in 1708 he was chosen a member of the Academy of Sciences, to which he had presented some memoirs on geometry. For nearly 50 years he continued to be one of its most active members, his labors embracing the arts, natural philosophy, and natural history. He was appointed to assist in the 'Description des Divers Arts et Métiers,' published by the Academy, and in executing his part of the undertaking pointed out the way to various improvements by the application of the principles of physics and natural history. He made important observations on the formation of pearls, and discovered that the "turquoises" of Languedoc consisted of the fossil teeth of extinct animals; but among his most useful researches must be reckoned those of which he gave an account in his 'Traité sur l'Art de Convertir le Fer en Acier, et d'Adoucir le Fer Fondu' (1722), in which he first made known in France the process of manufacturing steel. He received therefor a pension of 12,000 livres (about \$2,400). As a natural philosopher he is principally celebrated for the invention of an improved thermometer, which he made known in 1731. (See THERMOMETER.) The fabrication of porcelain also occupied much of his attention, and led him to the discovery of a kind of enamel, called the porcelain of Réaumur, in 1739. His 'Mémoires pour Servir à l'Histoire des Insectes' (1734-49) places him in the first rank of modern naturalists. In it he demonstrated, among various things, the correctness of Peyssonnel's assumption that corals are not plants, but animals.

Reavis, James Bradley, American lawyer and jurist: b. Boone County, Mo., 1848. He entered Kentucky University, but did not complete the course, was admitted to the bar in Hannibal, Mo., in 1872, and for two years was editor of the *Monroe City Appeal*. In 1874 he removed to the West, finally settling in Washington Territory, where he established a law practice. He was a member of the upper house of the territorial council in 1888, and a regent of the territorial university, until Washington became a State. In 1889 he was an unsuccessful candidate for supreme judge, and from 1896 to 1902 was chief justice of the Washington supreme court.

Rebaptizers, those who taught that the repetition of baptism was under certain circumstances imperative. The term is specifically used of the Baptists who enforce rebaptism in the case of all who have not been baptized by immersion. Views with regard to rebaptism have been varied. Many early Christians declared it unnecessary even for one who had been baptized by an unbeliever, or by a child in play. In doubtful cases the hypothetical or conditional form was enjoined, as in the Book of Common

Prayer, and in accordance with the decretal of Alexander III. (1159-81).

Re'bec, or **Rebeck**, a stringed musical instrument of the violin kind, said to have been introduced by the Moors into Spain. It soon became popular all over the Continent, being the favorite instrument of minstrels, and of village musicians, and up till the end of the 17th century, playing the same important part at fairs, rustic games, and weddings as does the violin at the present day. It was somewhat larger than the latter instrument, but had only three strings, which were tuned in fifths, and rubbed with a bow. The neck of the rebec terminated in a more or less grotesque representation of a human head.

Rebecca, a character in Scott's 'Ivanhoe', daughter of the Jew, Isaac of York. She falls in love with Ivanhoe and nurses him after the tournament of Ashby, and he in turn saves her life by appearing as her champion in the lists after she has been convicted of sorcery and condemned to be burnt at the stake. She departs from England with her father to live in Spain.

Rebec'caites, or **Rebekah's Daughters**, a singular association formed in South Wales, in 1839, for the destruction of turnpike-gates and toll-houses. The rioters were generally dressed in women's clothes, under a leader in the same guise, and made their attacks by night on horseback. The curious appellation by which they designated themselves was derived from the scriptural passage regarding Rebekah—"Let thy seed possess the gate of those who hate them." Successful for a time they were emboldened to greater lawlessness, and were attacked and dispersed by the military.

Rebekah Lodges. See ODD FELLOW.

Rebel Yell, the cry of the Confederate troops as they rushed to battle in the Civil War, although as a matter of fact, they frequently shouted the names of their States, as "On Virginia!" "On North Carolina!"—and so forth. It is difficult to interpret the rebel yell in written language. It was very different from the full-toned hurrah of the North, being more like a shriek. Near the crisis of a charge, the men would change from a double-quick to a mad rush, wildly yelling, "Y-Yo Yo—Wo-Wo," for the triple purpose of encouraging each other and confusing and terrorizing the enemy.

Rebellion, an uprising with force and arms against established authority. A rebellion may be an armed outbreak for the purpose of obtaining the redress of a grievance, or preventing the enforcement of an obnoxious law, Shays' Rebellion in Massachusetts having been an example of the former, and the Pennsylvania Whiskey Insurrection of the latter. Rebellion of a more formidable character is that which attempts to establish a new and independent organization in place of the existing government. Such was the American Revolution, and such also was the unsuccessful attempt to perpetuate the Southern Confederacy. Old World rebellions have been chiefly dynastic at least up to the 19th century—that is, wars between reigning families, and others, usually akin to them, which claimed the right to rule. The rebellion against Charles I. of England was of a different character, being prompted by aspirations for civil liberty and religious reform. The expulsion of James II.

REBELLION — RECAPITULATION

was of a similar motive, and the American Revolution was a struggle for the inalienable rights of man.

In former ages, and up to a very recent period, conquered rebels were treated with great severity, being put to death, maimed, or enslaved. In partly civilized countries such as China rebels are treated even now with the greatest cruelty. The more advanced nations, however, while retaining on their statute books the Draconic code of times gone by, treat beaten insurgents with leniency. After the downfall of the Southern Confederacy the only penalty inflicted was the disfranchisement for a time of the leaders of the rebellion, all being eventually admitted to the full rights of citizenship. British subjects who took sides with the Boers in the late South African war were, when convicted, imprisoned for short terms and disfranchised, although most of them probably escaped all punishment.

With the extension of suffrage came a consequent ability of the people to secure redress of wrongs without resort to violence. The causes which provoked rebellion in olden times are disappearing, while, apart from Carlist insurrections in Spain, there have been no dynastic rebellions in Europe for many years past.

Rebellion, War of. See CIVIL WAR IN AMERICA.

Reber, rä'bër, Franz von, German art-historian: b. Cham, Bavaria, 10 Nov. 1834. He studied in Munich, Berlin, and Rome, became a lecturer at the University of Munich in 1858, was appointed professor at the Polytechnicum there in 1863, and in 1869 occupied the chair of history of art in that institution. In 1873 he became director of the Royal Gallery. He has translated Vitruvius' 'Architecture' (1865) and Rooses' 'History of the Antwerp School of Painting' (1880), and has written: 'Geschichte der Baukunst im Altertum' (1864-7); 'Kunstgeschichte des Mittelalters' (1886); 'Geschichte der Malerei vom Anfang des 14. bis zum Ende des 18. Jahrhunderts' (1894); 'Die phrygischen Felsendenkmäler' (1897); etc.

Reber, rä-bär, Napoleon Henry, French composer: b. Muhlhausen, Alsace, 1807; d. Paris 1880. After studying with Reicha and Le Sueur, he wrote chamber music of remarkable merit, and in 1851 was appointed professor in the Conservatory, and succeeded Halévy in the chair of composition 1862. Among his works are: 'Le Diable Amoureux' (1840), a ballet; 'Le Nuit de Noël' (1848); 'Le Père Gaillard' (1852); 'Les Papillotes de M. Benoist' (1853); and 'Les Dames Capitaines' (1857), all four comic operas. He has also produced some instrumental work of a high order—four symphonies, one overture, one series for the orchestra, three stringed quartets, one stringed quintet, one pianoforte quartet, seven pianoforte trios, and miscellaneous pieces. His 'Traité d'Harmonie' (1862) is a standard work.

Rebis'so, Louis T., American sculptor: b. Italy 1837; d. Norwood, near Cincinnati, Ohio, 3 May 1899. At 20 he joined in Mazzini's attempt to establish an Italian republic (see MAZZINI, G.), and was obliged to leave Italy. Taking refuge in the United States, he settled in Boston, Mass. Subsequently he went to Cincinnati, Ohio, where his fame as an artist de-

veloped. His leading works are the equestrian statues of Gen. McPherson in Washington, D. C.; of Gen. Grant in Lincoln Park, Chicago, and of Gen. W. H. Harrison in Cincinnati.

Re'b-us, a mode of expressing words or phrases by pictures of objects whose names bear a resemblance to those words, or to the syllables of which they are composed. Many of the ancient coats of arms were rebuses on the names of those who bore them; thus a lock and a heart for the name of Lockhart, an eye and a ton (a barrel) for that of Eyton, etc. In heraldry, a rebus is a device intended to represent a proper name by a picture; a bearing or bearings on a coat of arms, containing an allusion to the name of the owner; as in the coat of the family of Arches, which consists of three arches, two simple and one double, borne on a shield; and that of the Dobell family, who bore on a sable shield a doe passant, between three bells argent.

Recall. See REFERENDUM.

Récamier, rä-kä-mê-ä, Jeanne Françoise Julie Adelaide Bernard, French social leader: b. Lyons 4 Dec. 1777; d. Paris 11 May 1849. She was educated at the convent of La Deserte. At 16 she went to Paris, whither her father, a wealthy banker, had transferred his business. Her extraordinary beauty and talents brought round her shoals of suitors belonging to the world of letters, finance, and politics, and in 1793 she was married to Jacques Récamier, a rich banker, more than double her own age. The Récamier salon was long filled with many of the celebrities of the day. Though she wrote nothing, she, by her confidential intercourse with Chateaubriand and others, exercised no slight influence on French literature. Under the Empire she was opposed to Napoleon, as he had placed her father under surveillance for his royalist tendencies, and Napoleon took his revenge by refusing to support the bank of her husband during a crisis. It accordingly failed, and Madame Récamier was obliged to quit Paris. She took up her residence with her friend Madame de Staël at Coppet, and afterward traveled, like her, till the downfall of Napoleon, when she again opened her salon in the Abbaye-aux-Bois at Paris. Her 'Recollections and Correspondence' appeared in 1859.

Recapit'ulation, or Biogenetic Law, in zoology, terms applied to the parallel which exists between the embryonic development of an individual animal (ontogeny) and the historical evolution of its race (phylogeny). This parallel is explained by the theory of evolution (q.v.), according to which, in the words of Sidgwick, "the developmental history of the individual appears to be a short and simplified repetition, or in a certain sense a recapitulation, of the course of development of the species." This class of facts was recognized more or less completely by the earliest naturalists, and were extensively studied and formulated by Von Baer and Agassiz previous to the explanation of them by means of the doctrine of descent; but it should be added that obscurities still exist, concerning the explanation of which embryologists are in doubt or at variance. Examples may be found in the embryological development of all vertebrates. Thus the frog develops through stages in which the embryo just before hatching is very fish-like, after hatching becomes a tad-

RECEIPT — RECHABITES

pole which exhibits many newt-like characters; and finally reaches the permanent frog stage. This accords with the comparative rank of the fish, newt and frog groups in classification; and also with the succession appearance of these groups. Man, as the highest animal, exhibits most completely these phenomena. In the earliest stages the human embryo is indistinguishable from that of any other creature. A little later the cephalic region shows gill-slits, like those which in a shark are a permanent feature, and the heart is two-chambered or fish-like. Further development closes the gill-slits, and the heart changes to the reptilian type. Here the reptiles stop, while birds and mammals advance further; but the human embryo in its progress to the higher type recapitulates and leaves features characteristic of lower mammalian forms — for instance, a distinct and comparatively long tail exists. Most of these changes are completed before the embryo is six weeks old, but some traces of primitive and obsolete structures persist throughout life as "vestiges" or "rudimentary organs," and others appear after birth in infancy, as the well-known tendency of babies to turn their feet sideways and inward, and to use their toes and feet as grasping organs, after the manner of monkeys. This recapitulation of ancestral characters in ontogeny is not complete, however, for not all the stages are reproduced in every case, so far as can be perceived; and it is irregular and complicated in various ways, among others by the inheritance of acquired characters. The most special students of it, as Haeckel, Fritz Müller, Hyatt, Balfour, etc., distinguish two sorts of recapitulation "palingenesis" and "cœnogenesis," the last manifested most completely in the metamorphoses of insects. See EMBRYOLOGY, and consult authorities mentioned thereunder.

Receipt, in law, a written document, declaring that certain goods or a sum of money have been received. When made out in full, a receipt should contain (1) the date when the merchandise or money was received, (2) the name of the person or firm from whom received, (3) the name of the person who received it, and (4) for what the money is paid or deposited. A receipt may be in full or in part payment of an account, and operates accordingly. A receipt, though evidence of payment, is not absolute proof, and this evidence may be rebutted by proving that it was given under misapprehension.

Receiver, in law, is an officer of the court through whom the court, on account of its jurisdiction, takes possession of property which is the subject of a suit, for the purpose of preserving it from injury or loss, secures the proceeds and finally disposes of them according to the rights of all parties interested. Receivership is a remedial agency for the purpose of preserving the property in question from waste, destruction or deterioration pending litigation; it is auxiliary to the main action. It is a remedy which originated in the English Court of Chancery and is purely equitable. Under the existing English law, and also that in Canada, a receiver may be appointed when the court deems it just or convenient. In the United States, courts of equity have general authority to appoint receivers, and in most States by statutory provision. The courts are generally disinclined to appoint

a receiver, except that from all the circumstances it appears essential for the purpose of the preservation of the property in controversy. Technical injuries and circumstances which are doubtful are insufficient. A receiver will be appointed to prevent a fraudulent transfer, or possession of property, or for the protection of estates, or of property of a partnership where dissolution is desired and the partners cannot agree; of mortgaged property, foreclosure proceedings, corporations which are insolvent, or which are fraudulently managed. The appointment of a receiver rests entirely within the discretion of the court to which the application is made, and the court also has discretion as to its choice of receiver. One will not be appointed a receiver who is not qualified to perform his duties, and he must be impartial, independent and disinterested. A corporation may be appointed a receiver if authorized by its charter. In order to obtain a receiver one must show the right to the property, or a lien upon it, or that the property in question was obtained by fraud, or is in danger of loss from waste, or the misconduct or insolvency of the party in possession, and the circumstances must show extreme necessity. A receiver is created by the court whose officer he is and is under its control, supervision, and protection. His duty is purely ministerial and the utmost good faith is required of him; his acts should be with the general or special authority of the court and must be without discrimination for the interests involved. A receiver may employ counsel, agents and assistants, make necessary repairs, pay taxes and bring suits: he must keep the property insured and is required to give a bond for faithful performance of his duty. He takes complete possession of the property at the time when appointed; his liability is generally official, and he is responsible to any person who sustains loss through his negligence or misconduct in relation to his trust; he is entitled to a compensation for his services, which is in some jurisdictions fixed by statute, in others by the discretion of the court.

Recent Period, that division of the geological time-scale including the most recent portion of geological history. It is usually thought of as beginning with the appearance of man on the globe and running down to the present, and is therefore sometimes called the Human Epoch. It follows immediately upon the Pleistocene Period (q.v.) and is treated as a subdivision of this by some geologists, while others group Pleistocene and Recent under the Quaternary Period (q.v.). See GEOLOGY.

Rechabites, rēk'ā-bīts, members of a kind of religious order in ancient Israel whose rule was in some respects like that of the Nazir or Nazarites: like them they were bound by vow to abstain from the use of wine. In their contempt for luxuries and the ways of settled life, they chose to live in tents rather than houses, and refused to sow grain or plant vineyards; their ideal was the nomad patriarchal life amid their flocks. The order had its origin in the northern kingdom of Israel, and was founded by Jonadab or Jehonadab, son of Rechab (whence the name Rechabites), in the reign of Jehu, king of Israel (2 Kings x.). After the fall of the kingdom of the North a body of the Rechabites entered the kingdom of Judah and

continued to live apart from cities and towns till at the approach of Nebuchadnezzar they took refuge in Jerusalem. Independent Order of Rechabites is the style of a total-abstinence beneficial society founded in England 1835 and of which a branch was instituted in the United States 1842. In 1902 the order had 270,000 members and the disbursements of the previous fiscal years were \$793,682; in the United States the Rechabites had three "tents," 35 "sub-tents."

Recife, Brazil. See PERNAMBUCO.

Reciprocal, in grammar, reflexive. Applied to verbs which have as an object a pronoun standing for the subject; as, "Bethink yourself." It is also applied to pronouns of this class. As a noun, that which is reciprocal to another thing. Specifically, in mathematics, the quotient resulting from the division of unity by the quantity. The reciprocal of a vulgar fraction is the denominator divided by the numerator.

Reciprocity. See UNITED STATES, RECIPROCIDY.

Recitative, rēs'ī-tā-tēv' (Italian, *recitativo*), a species of musical recitation, forming the medium between song and rhetorical declamation, and in which the composer and performer, rejecting the rigorous rules of time, endeavor to imitate the inflections, accents, and emphasis of natural speech. Although the rules of time and rhythm are not strictly observed, recitative is written generally in common time, in order to facilitate the reading. In its approach to speech, therefore, recitative is mostly syllabic song, that is, each syllable has generally but one tone, and the tones themselves are less prolonged than in *song* strictly so called. Hence recitative has not a distinct, developed melody, and a regular modulation; it may, according to the meaning of the words, pass with comparative freedom through the various tones. On the other hand, the tones of recitative are generally musical tones, of distinct height or depth generally, because in *recitativo parlante*, in the *opera buffa*, the tones become closely allied to those of speech. When recitative approaches still more to strict song, in respect to time and melody, the *arioso* originates. In short recitative may be called *declamation in musical tones*. Recitative includes the simple (by some also called the *parlante*) and the accompanied, or more properly, the *obbligato*. In simple recitative accompaniment also takes place, but it consists only in simple chords, which are given continuously, or interruptedly. In the *obbligato* recitative the instrumental accompaniment is of more importance, and consists of either sustained chords by the greater portion of the orchestral instruments, or even of florid passages. In the recitative much is left to the singer in respect to time, rhythm, and melody, which require much musical judgment and knowledge of harmony, in order to agree with the *obbligato* accompaniment. Peri Caccini and Monteverde are celebrated as having introduced the modern recitative. See OPERA.

Recke, rēk'ē, Ernst von der, Danish poet: b. Copenhagen 14 Aug. 1848. His first work was a lyrical drama, 'Bertram of Born' (1873), performed with great success at the Theatre Royal at Copenhagen. Following this came 'King Liuvigild and his Sons' (1878), a

tragedy; a dramatic poem 'Archilochus' (1878); 'Knud and Magnus' (1881), a tragedy; 'Fru Jeanna' (1891), a tragic opera; and the 'Duchess of Burgundy' (1891). Between 1876 and 1890 he published several collections of lyrics and in 1881 a great work representing six years of labor in a field in which he is a recognized master, 'Principles of Danish Versification as Manifested in his Historic and Systematic Development.' Besides writing books for children he has published translations of Bornier's 'La Fille de Roland' (1876) and Rostand's 'Les Romanesques' (1896).

Recklinghausen, rēk'ling-how-zēn, Prussia, in the province of Westphalia, 15 miles northwest of Dortmund. It has good Catholic and Protestant schools. Its manufactures include damask, wicks, tobacco, and bricks. There are coal mines in the vicinity.

Réclus, Jacques Elisée, zhāk ā-lē-zā rā-klū, French geographer: b. Sainte-Foy-la-Grande, in the Gironde, 15 March 1830; d. Brussels, Holland, 4 July 1905. After being educated in the college of his native town and at the University of Berlin, he traveled in Germany, England, Ireland, and America. In 1859 he began to contribute to the 'Revue des Deux Mondes' articles on geography, geology, literature, politics, social economy, and other subjects, and also became associated with several geographical journals. During the siege of Paris and the Commune he was a member of the National Guard. Captured early in 1871 he was condemned to deportation, but his sentence was commuted to exile, and he spent some years in Italy and Switzerland. In 1883 the Tribunal at Lyons passed sentence upon him and Prince Kropotkin as being anarchistic leaders associated with the International Workingmen's Association, but Reclus escaped punishment by his absence from the country. In 1892 he was appointed professor of comparative geography in the free university of Brussels. His greatest work is his 'Nouvelle Geographie Universelle: La Terre et les Hommes' (1875-94), a splendid monument of the best geographical learning of our time. There is an English translation by Ravenstein and Keane (1887 onward). His other works include: 'La Terre: Description des Phénomènes de la Vie du Globe' (1867-8), translated into English as 'The Earth' (1871); 'Histoire d'un Ruisseau' (1869); 'Nice, Cannes, Antibes, Monaco, Menton, San Remo' (1870); 'Les Phénomènes Terrestres: Les Mers et les Météores' (1873); 'Histoire d'une Montagne' (1880), translated as 'The History of a Mountain' (1881); and 'L'Evolution, la Révolution et l'Idéal Anarchique' (1898), treating of his social philosophy.

Recognition Marks. See COLORATION, PROTECTIVE.

Recognizance, or **Recognisance**, in law, an obligation of record, which a man enters into before some court of record or magistrate duly authorized, with condition to do some particular act; as, to keep the peace, to pay a debt, or the like.

Recollet, rēk'ō-lēt, or **Recollect**, the name given to certain reformed bodies of the Franciscan and other orders in the Roman Catholic Church. The reformed society was founded in Spain by Juan de la Puebla y Sotomayor, conde

RECONCENTRADO — RECREATIVE RELIGIONISTS

de Belalcazar, in 1484, was admitted into Italy in 1525, and into France in 1595. Thence they spread rapidly into Belgium and Germany. In France, before the Revolution, they had 168 houses, forming seven provinces, under the direction of the general of the Cordeliers. The order still exists at Medina, Sidonia, Leon, and Pamplona. It is also known as the Friars Minor of the Strict Observance of St. Francis. See also **ORDERS, RELIGIOUS**.

Reconcentrado, rē-kōn-sēn-trā'dō, a Spanish term applied to the inhabitants of the rural districts of Cuba, whose sufferings, caused by their treatment at the hands of the Spanish authorities, had much to do with provoking war between the United States and Spain. Governor-General Weyler issued a decree that all of the peasant class not actively engaged in the insurrection but at their homes or ranches, should be "reconcentrated" in or near certain towns, disobedience to this degree incurring the penalty of death. Accordingly, these people, non-combatants and mostly old men beyond the ability of army service, feeble old women, children, and babies, were forced to leave their homes and to gather in herds in and near these towns, where they were without food and shelter, "reconcentrated" to starve and to suffer from exposure to the weather and lack of all comfort. These helpless victims were called "reconcentrados." General Weyler's purpose was to desolate the island in certain parts so that the insurgents could not get aid and food. With this end in view, the abandoned homes were destroyed and whatever remained of value to the Spaniards was confiscated. Whole districts in the most productive part of the island were thus laid waste. Sugar mills were burned and other industrial property was destroyed. Nearly 400,000 "reconcentrados" were forced to go within the Spanish lines, where no means of subsistence were provided for them. More than 200,000 died of starvation and disease, an appalling record in modern civilization. When the decree, under General Blanco, was issued to permit the reconcentrados to return to their homes, there was but desolation where their homes had been. It was at this time that the American relief work, Red Cross ministrations, and other help availed this helpless class, but not to the full extent of their capacities till the American army and navy had driven Spanish rule from Cuba. The British followed a similar course in the Boer war, but with much less inhumanity.

Reconnaissance, rē-kōn'ā-sans, usually the examination of a territory, district, etc., or of an enemy's position, for the purpose of directing military operations. Also the preliminary examination of a county or district in reference to its general natural character, preparatory to a more particular survey for the purposes of triangulation or the construction of public works, as of a road, canal, railway, etc.

Reconstruction. See **UNITED STATES, RECONSTRUCTION**.

Record includes anything which is set down in writing for the purpose of preserving memory, and may be of a public or private nature. A record in a law suit is a complete written history of it from its beginning to its determination made by an officer duly authorized. All books and memorials kept by public

officers in accordance with the law, or which are connected with the proper discharge of their duty, are regarded as public records, as are also copies of papers which statutes require to be filed in public places. Generally anyone has a right to inspect public records, and in many jurisdictions the removal of public records is regulated by statute, some of which hold that to destroy, or remove, or injure the records is a criminal offense.

Record, rēk'ōrd, **Robert**, English mathematician b. Tenby, Pembroke, about 1510; d. London 1558. He studied at Oxford, was elected to a fellowship of All Souls' in 1531, studied, and probably taught, mathematics and medicine at Cambridge, and later was instructor in a variety of subjects at Oxford. Having gone to London, he became, it is said, physician to Edward VI. and Queen Mary. In 1551 he was made general surveyor of the mines and money; but despite this post seems to have been imprisoned for debt in King's bench prison, where he certainly died. Among his works were: 'The Grounde of Artes' (1540-1699); 'The Urmal of Physick' (1547), a comprehensive treatise on medicine; 'The Pathway to Knowledge, or First Principles of Geometry' (1551-1602); 'The Whetstone of Witte, or the Second Part of Arithmetike' (1557), the former a treatise on geometry, the latter on algebra; 'The Castle of Knowledge, a Treatise on Astronomy and the Sphere' (1551). For over a century his mathematical works were used as text-books in the schools of England. He was the first to use the sign = for equality, and to discover the method of extracting the root of multinomial algebraic expression.

Recor'der, in New York, the title of one of the criminal judges. The title is of ancient English derivation, the recorder in England being a person associated with the mayor and other magistrates of any city or borough, having jurisdiction in a court of record, for their better direction in matters of justice and proceedings according to law. The title of recorder is also given in some American States to an official having charge of real estate and other records.

Recorder, an obsolete musical instrument, formerly popular, resembling a flageolet in shape, with a mouth-piece like a bird's beak. The instrument was wider in the lower half than in the upper; its tones were soft and pleasing and an octave higher than the flute. Milton speaks in his 'Paradise Lost' of

The Dorian mood
Of flutes and soft recorders:

and it is also mentioned by Shakespeare in 'Hamlet.'

Recreation Piers, piers on the river-front in several of the large American cities maintained as places of recreation for the people, and usually crowded on warm nights in the summer months by those who cannot afford to go out of the city to summer resorts. Music is furnished at the public expense, and order is maintained by the police. Standing forth preeminent and as the leader among the cities providing such breathing-places for the poor is New York City which in 1903 had seven, three located on the East River and three on the North River, Manhattan, and one in Brooklyn, two of which are also open in winter.

Rec'reative Religionists, the name of an association formed in London 1866 for the pur-

pose of providing on Sunday evenings popular lectures on scientific subjects with sacred music at intervals. An effort was made to suppress the work of the association under the provisions of the "Sunday Act," 21 Geo. III. ch. 49, but it failed, and the Recreative Religionists or Sunday Lecture Society now figures in the registrar-general's report among "sects having registered places of worship."

Recruiting. See **REGULAR ARMY.**

Rectangle, in geometry, a parallelogram or quadrilateral figure whose angles are all right angles. An equilateral rectangle is a square. A rectangle is said to be contained by any two of the sides about one of its angles; thus, if A B and B C represent two adjacent sides, the rectangle is said to be contained by A B and B C, or, as it is sometimes expressed, it is the rectangle under A B and B C. The area of a rectangle is equal to the product of its base and altitude. Rectangles having equal bases are to each other as their altitudes: rectangles having equal altitudes, are to each other as their bases.

Rectify, to refine common alcohol or spirit by distillation. The process of rectifying begins after the spirit itself has been distilled, and consists in removing the impurities from the spirit by fractional or repeated distillation, so far as possible, for it is impossible in this way to get rid of fusel oil. Whiskey, brandy, and rum, if genuine, are made from rectified spirit. See **DISTILLED LIQUORS.**

Rector, in the Protestant Episcopal and Roman Catholic churches, is the clergyman who has the complete charge and care of a parish church. The term rector is also applied in some monastic orders to the chief officer of a convent; and again to designate the heads of universities, colleges, academies, schools, and other educational corporate establishments.

Rectum, the lower portion of the large intestine or colon. The term, however, is a misnomer so far as the human anatomy is concerned, for the bowel adapts itself to the curves of the sacrum, and at one point doubles upon itself. The rectum is from six to eight inches long, extending from the sigmoid flexure to the anus, and is narrowest at its two extremities. The largest and most dilatable portion (ampulla) just above the levator-ani muscle, forms a sort of pocket in which feces, etc., lodge. The rectum has a mucous coat (membrane), gathered into transverse folds (Houston's valves), forming compartment-like spaces; a submucous and a muscular coat; and at the upper portion, where there is little motion, a peritoneal coat (mesentery).

The tendency of specialists is to consider the rectum as only that part of the bowel below the third sacral vertebra, and devoid of mesentery, and to divide it into two portions, the fixed rectum and movable rectum. The rectum is in close opposition with large pelvic vessels and nerves and a portion of the small intestine; also, in the male, with the bladder, urethra, and prostate gland; and in the female, with the uterus, vagina, and Douglas' cul-de-sac. Its lower portion is surrounded by the hæmorrhoidal plexus of veins. The vessels forming this plexus, as also those of the vaginal and vesicoprostatic plexuses, are very large, frequently

communicate, and have many valves. It is in the lower portion of the rectum that hæmorrhoids or piles and many other painful affections occur, as blood-vessels and nerves are numerous, and the muscles powerful.

Diseases of the Rectum.—These include congenital imperfections. The rectum may even be absent, or partially developed, terminating in a blind pouch; or it may abnormally open into the bladder, vagina, uterus, or urethra. These imperfections can be usually remedied by the surgeon.

Threadworms or pinworms frequently inhabit the rectum and cause itching about the anus (*pruritus ani*). They may be destroyed by injections of lime-water or a solution of ox-gall. Abscesses (caused by blows, perforation, sitting upon cold, damp seats, etc.) may form in the loose areolar tissue about the lower part of the rectum and open externally or into the rectum, leaving a fistulous tract (*fistula in ano*). Benign tumors, fibroma, papilloma, and adenoma, and also carcinomatous and sarcomatous tumors may form in the rectum. Hæmorrhoids, due to disease or a weakened condition of the hæmorrhoidal veins, are common, especially in persons who are on their feet a large part of the time and who are engaged in sedentary occupation. Hæmorrhoidal affections may be relieved by astringents or by operation. Polypus of the rectum (soft and hard), comparatively frequent in childhood, is a tumor resembling in shape a berry or a pear, and having a peduncle. It sometimes bleeds and protrudes at the anus after stool. It is composed of elongated follicles and a network of small blood-vessels. It may be removed by a ligature or by an appropriate instrument. Prolapsus of the rectum, due to a relaxed state of the sphincter-muscles and the coats of the rectum, may be either incomplete or complete, with protrusion from the anus (*prolapsus ani*). It is observed generally in young children and women, and is brought on by bearing-down strains. Treatment requires the replacing of the bowel and keeping of it in place; and astringents, caustics, and operation are employed as may seem advisable. Stricture of the rectum, or narrowing of its calibre, may be very limited in extent, or may include a considerable portion of it, and is due usually to malignant or syphilitic ulceration. The symptoms include difficult defecation, more or less purulent and bloody discharges, and pain. If not relieved, it affects the general health. Treatment consists of dilatation with rectal bougies, or division of the cicatricial tissue by instruments (*colotomy*). Ulceration of the rectum may be due to simple inflammation or to dysentery, tuberculous disease, syphilis, or malignant disease. Symptoms vary with the character of the sores and their location. There are usually discharges of pus, blood, and mucus, and some pain and tenesmus. Treatment depends on the nature and extent of the disease and the constitutional condition of the patient. It includes the keeping of the bowel as quiet and free from fecal matter as possible, the use of simple food, saline aperients, and vegetable astringents, or nitrate of silver. Fissure of the anus, or a tear of its mucous membrane, may extend into the rectum, or a fissure of the rectum may exist by itself. In either case the fissure is

RECUSANTS—RED-BELLIED SNAKE

usually produced by the passage of hardened faeces and the attendant straining. It is sometimes obstinate. Treatment calls for regulation of the bowels, dilatation, and the application of nitrate of silver or other astringent. Neuralgia of the rectum is sometimes mistaken (before an examination of the rectum is made) for fissure. Treatment as in other neuralgias, except when it is caused by pressure of a displaced coccyx upon sacral nerves. This bone must then be replaced or removed.

Intestinal calculi (enteroliths), gallstones, and faecal concretions containing, it may be, fruit-stones or berry-seeds, are occasionally found in the rectum. They give rise to more or less tenderness and abdominal pain, severe and intractable constipation, cold perspiration, vomiting, thready and rapid pulse, etc.; and they must be removed. Invagination or intussusception of the rectum, of the upper portion into the lower, as the result of strain and weakened rectal walls, requires surgical aid.

Regular and free movements of the bowels, unattended by straining, are of the greatest importance in the treatment of most rectal ailments, and preventive of many. The fact that the lower portion of the rectum is capable of holding a large amount of hardened faecal material, while the more liquid matter readily flows by it and out of the body, is not generally understood.

Recusants, rĕk'ū-zants or rĕ-kū'zants, a term in use under the penal laws of England, when it was sought to force the consciences of the people by legal punishments. Recusants were those persons who refused or neglected to attend divine service on Sundays or holidays in the Established Church, or to worship according to its forms. The word is first met with in temporal courts in the first year of Queen Elizabeth, when it was enacted that all persons who, without reasonable excuse, failed to attend some usual place of prayer, should be censured and fined for every offense 12 pence. In 23 Elizabeth the fine was made for every month £20; and later in the same reign it was enacted that if recusants did not submit within three months after conviction they might, upon the requisition of four justices of the peace, be compelled to abjure and renounce the realm; and if they did not depart, or if they returned without due license, they were to be treated as felons, and suffer death without benefit of clergy. In the case of Roman Catholic recusants the laws were more severe. They were liable to a forfeit of 100 marks (£66, 13s. 4d.) for hearing mass; for saying it the fine was doubled, and in both cases they had to undergo a year's imprisonment. They were disabled from taking lands either by descent or purchase after the age of 18, unless they renounced their errors, and could not keep or teach schools under pain of perpetual imprisonment. After a first conviction, they could not keep arms in their houses, could not appear within 10 miles of London, could not travel five miles from home without license, could not hold any public office, could not have marriage, baptism, or burial performed, except by a minister of the Established Church; could not bring any action at law or equity, all under penalties of fine and imprisonment. By the Toleration Act (1 Wm. and Mary, ch. 18) all persons dissenting from

the English Church, except Roman Catholics and anti-Trinitarians, were allowed to meet for purposes of worship according to their own forms on taking the oaths of allegiance and supremacy. The act was extended to include Unitarians in 1813, and in 1829 the Catholic Emancipation Act granted toleration to Roman Catholics.

Red, one of the three primary colors. Mixed in equal strength and proportion with the other primaries, it yields secondaries, for example, with yellow it forms orange; with blue, violet, etc. Also a pigment. The most useful red pigments are carmine, vermilion (sulphuret of mercury), chrome-red, scarlet-lake (biniodide of mercury), madder-lake, light red, burnt sienna; these are yellow reds. Venetian red, Indian red (carbonate of oxide of iron), and crimson-lake are blue reds.

Red Admiral, a butterfly of the genus *Vanessa*, especially *V. Atalanta*, so called by British collectors. See ADMIRAL.

Red-backed Mouse, a small, chestnut-backed wood-mouse (*Evotomys gapperi*) closely related to the meadow-mouse, which is common throughout the eastern half of the United States and in the Saint Lawrence Valley, and has the general habits of a meadow-mouse.

Red-backed Sandpiper, the dunlin (q.v.).

Red Bank, N. J., town, in Monmouth County; on the Shrewsbury River, at the head of navigation, and on the Central of New Jersey, the New Jersey Southern, and the Pennsylvania R.R.'s; about 25 miles south of New York. It has regular steamer connection with New York, Atlantic Highlands, and other ports. Settlements were made in the vicinity in 1650, by English and Dutch colonists. It was incorporated as a town in 1872. It is an attractive residential town, and a favorite summer resort. It has a number of industrial establishments, chief of which are a large canning factory, carriage shops, clothing factory, boiler works, gold-beating works, and brush factory. About 500 persons are employed in the manufactures. The trade is chiefly in manufactures, farm products, and fruit. It has nine churches. The educational institutions are the Shrewsbury Academy, several private schools, a high school which cost \$60,000, public and parish schools, and a public school library. The government is vested in a board of commissioners of five members, elected annually. Pop. (1890) 4,145; (1900) 5,428; (1910) 7,398.

JOHN H. COOK,

Editor 'Red Bank Register.'

Red Bat, a small reddish bat (*Lasiurus borealis*) common in the Eastern United States. See BAT.

Red-bellied Hawk. See RED-SHOULDERED HAWK.

Red-bellied Snake, a harmless snake (*Storeria occipitomaculata*) of the Eastern United States, whose belly is salmon red. It is dull brown above, with a paler stripe along the spine, bordered by one or more rows of blackish dots; a constant feature is three pale reddish blotches on the occiput. Its size and habits are similar to those of the garter-snakes. Two or three other species in the West have red bellies, and are sometimes locally known by the same name.

RED BOOK—RED CROSS SOCIETIES

Red Book, an English government book containing the names of all persons in the service of the state.

Red-breasted, or **Robin, Snipe**, a dowitcher (q.v.).

Red Bug, or **Cotton-stainer**. See **COTTON INSECTS**.

Red Cedar. See **CEDAR**.

Red Cloud, Sioux Indian chief: b. about 1818. He first came into prominence as leader of the Indians in the Fetterman massacre near Fort Phil Kearny, Wyoming, in December 1866. In this event 100 men under Capt. Fetterman and Lieut. Brown, comprising the entire command, were slain. Red Cloud then became the acknowledged leader of the warrior Sioux, established a military dictatorship, and terrorized the region over which he ruled. In 1874 the Indians abandoned the North Platte country and went to the Red Cloud agency on the White Earth River, whence they continued under Red Cloud to make frequent raids. In 1880 he made a treaty of peace with the government which he faithfully observed.

Red Cloud, Neb., city, county-seat of Webster County, off the Republican River, and on the Chicago, Burlington & Quincy railroad; about 110 miles in direct line southwest of Lincoln. It is in an agricultural and stock-raising region. The chief manufacturing establishments are flour mills and machine shops. It has large lumber and stock yards and grain elevators. Its chief shipments are live-stock, wheat, corn, vegetables, and flour. The two State banks have a combined capital of \$40,000. Pop. (est.) 1,600.

Red Cross Societies, a general name for those societies founded for assisting the wounded in time of war, so named because their distinctive badge is a red cross on a white ground. Such societies have been established in all civilized countries as a result of an international conference held at Geneva in 1863, which was followed next year by an international convention agreed upon at the same place, at which the International Treaty of Geneva was accepted and signed by a number of different nations. According to this all hospitals and hospital officials, and all in any way engaged in attending the sick and wounded in war, are treated as neutral parties. The society in England has four branches, two ambulance branches, one volunteer nursing branch, and one branch to raise funds and supplies, and societies in other countries. There is an international committee at Geneva which serves as a centre of communication between the different Red Cross societies throughout the world. In connection with this may be mentioned the decoration of the Royal Red Cross instituted by Queen Victoria in 1883, as a reward for women who have exerted themselves in aid of sick and wounded soldiers and sailors in time of war. The enameled crimson-and-gold cross bears the words "Faith, Hope and Charity," with the effigy of her majesty, the royal and imperial cipher, etc., and is attached to a blue ribbon and worn on the left shoulder.

The first war to bring the Red Cross service into activity was that of 1866 in Germany, Austria, and Italy. Austria had not yet joined the compact, but her citizens raised and gave to the service almost \$500,000. Germany's societies

supplied over \$3,000,000, and 500 volunteers, men and women, entered the service. The Red Cross work during the war proved the incalculable value of the organization. The next call on the service was the Franco-Prussian war. In Germany, more than 2,000 committees were formed at the beginning of the conflict, with a central committee at Berlin. More than \$14,000,000 was raised and used. France had less resource in readiness, but she raised and used nearly \$2,000,000, and her service cared for more than 100,000 wounded men. The next demand on the Red Cross was in 1876-8, when Turkey, Servia, Montenegro, Greece, and Russia became embroiled. In the beginning of this period of its work, the Red Cross service was regarded with suspicion by the military, but was soon solicited to take control of its treaty-province. It raised almost \$17,000,000 and applied over \$13,000,000.

The Red Cross emblem found its first opposing force in Turkey. The Turkish soldiers regarded it as of religious significance, and so violent was their prejudice that a red crescent was substituted in order to secure speediest recognition and co-operation. In the Japanese army the Red Cross service has been wonderfully effective. In 1886, Japan entered into this international treaty, and the mikado became president of a Red Cross society in a civil capacity. In the Turko-Russian contest, in the Tunisian, the Tonkin, and the Madagascar wars, the Red Cross was notably active. In the Græco-Turkish campaigns its work and sacrifice were heroic.

National Red Cross.—This is an American body incorporated under the laws of the District of Columbia, 1 Oct. 1881, reincorporated 17 April 1893, and reincorporated by act of Congress, June 1900; for the relief of suffering by war, pestilence, famine, flood, fires, and other calamities of sufficient magnitude to be deemed national in extent. The organization acts under the Geneva Treaty. The United States gave its adhesion by act of Congress 1 March 1882; ratified by the Congress of Berne 9 June 1882; proclaimed by President Arthur 26 July 1882; headquarters, Washington, D. C. The introduction and development of the Red Cross movement in the United States were chiefly due to Miss Clara Barton, the founder of the American branch. Previous to the organization of this branch there were many members of the Red Cross Society in the United States with Miss Barton as their representative. When the national branch was regularly formed Miss Barton was chosen leader. In the United States no laws have been passed to regulate Red Cross work. The national branch has no sub-societies or sub-committees; but patriotic and sympathetic men and women as individuals, or united in societies, are at liberty to assist and to co-operate with the Red Cross in raising money and in providing nurses and whatever the service requires. Whenever needed, this co-operation is active in every State and in most of the Territories.

The American National Red Cross did relief work in the Russian famine of 1892, and in Armenia in 1896.

The Red Cross work in Cuba during the war, as measured by service and contributions, was phenomenal. The total value of gifts, including cash donations, reached nearly \$4,000,000.

RED DEER

1000. When peace was declared, there yet remained starvation, sickness, disease, destitution, and desolation on the island. The Red Cross continued indefatigable in its work. In all its Cuban undertakings volunteer assistance and contributions of supplies were received from France, England, Belgium, Holland, Switzerland, Germany, Italy, Denmark, and Mexico. Almost all the Red Cross work during the war with Spain was done by temporary Red Cross auxiliaries, and other aid societies which went out of existence at the end of the war, and which had little or no connection with the National Society beyond that implied by the name.

National Support.—The governments of the United States, Great Britain, Germany, and Italy give no regular financial support to the Red Cross societies. In 1882 Congress appropriated \$1,000 for printing Red Cross literature; and since then, from time to time, has appropriated various sums for special purposes, but otherwise the society has received no financial support from the government of the United States. In Germany the government grants the society permission to hold occasional lotteries to secure funds. France allows an indemnity of 20 cents a day for each sick or wounded soldier cared for by the society in time of war. The Netherlands government pays the salary of the secretary, provides office quarters, allows \$400 a year for office expenses, pays the traveling expenses of an officer whose duties in connection with the work of the society may necessitate his leaving his home. Belgium gives financial support in time of war. Denmark contributes annually \$1,000. Austria gives \$2,400 annually for assistance in case of epidemics or great calamities. Switzerland appropriates \$5,000 annually for a special purpose. The emperor and empress of Japan give annually \$1,250. Russia pays for men taken care of by the society in time of war, at a rate agreed upon with the minister of war. In 1900 the emperor sanctioned a tax of 2½ cents on certain railroad tickets and \$2.50 on passports, such extra tax to be for the benefit of the Red Cross Society. The membership of the society is as follows: In 1903, in the United States, 298 members of the National Society; France, 55,000; Austria, 52,209; Hungary, 42,041; Japan, 894,814; Germany, main branch and affiliated societies, 300,000. In several other countries the society is well organized, with a large number of physicians, nurses, and general equipment.

Consult: 'Red Cross Society in Foreign Countries,' Senate document No. 178 (1903-4); Du Camp, 'La Croix-Rouge de France'; Criegien, 'Das Rothe Kreuz in Deutschland'; Barton, 'History of the Red Cross'; 'History of the Red Cross in Peace and War'; quarterly bulletin published by the International Committee of Geneva, 'Bulletin International des Sociétés de la Croix-Rouge'; 'Memorial des Vingt-cinq premières années de la Croix-Rouge'; American Red Cross Relief Reports (New York).

Red Deer, or Stag, the common deer (*Cervus elephas*) of Europe and western Asia, which is typical of the family, and the ordinary "deer" of literature and poetry as well as of the chase. It much resembles the American wapiti, but is smaller and rather darker in general color. A fine specimen will stand four feet tall at the fore-shoulder and will weigh

about 300 pounds, but exceptional ones have weighed much more. Even larger are those of the Asiatic border and Asia Minor. The antlers of Scotch and Irish stags rarely exceed 33 inches in length; but those of eastern Europe and Siberia are far longer. Several different names have been given to the related deer of northern Asia, but they seem to be essentially the same as those of Europe, where they survive sparsely and under legal protection in almost all the countries. In the British Islands the wild red deer remains only in the Highlands of Scotland, but is "preserved" on many large estates and protected moors in both England and Ireland. The species is supposed to have been originally introduced into England from France, where it became very numerous, but since the 17th century it has been killed off in most parts of that kingdom to make way for the fallow deer, the venison of which is far superior, and the animal itself of a more manageable and placid disposition.

The stag has a fine eye, an acute sense of smell, and a good ear. When listening, he raises his head and erects his ears. When going into a coppice or other half-covered place, he stops to look round him on all sides, and scents the wind, to discover if any object be near that might disturb him. Though a simple, he is a curious and crafty animal. When hissed or called to from a distance, he stops short, and looks steadfastly, and, with a kind of admiration, at horses or men; and if the latter have neither arms nor dogs he moves on without betraying any symptoms of alarm. He eats slowly; and after his stomach is full, he lies down and ruminates at leisure.

In winter and spring this animal rarely ever drinks, the dews and tender herbage being sufficient to satisfy his thirst; but during the parching heats of summer, he not only frequents the brooks and springs, but searches for deep water wherein to bathe and refresh himself. He swims with great ease and strength, particularly when he is in good condition, his fat contributing to his buoyancy. His voice is stronger, louder, and more tremulous in proportion as he advances in age; and during the rutting season it is really fearful. The cry of the hind, or female, is not so loud as that of the male. The pairing season is in August; the time of gestation is between eight and nine months; and she seldom produces more than one at a time. The usual season of parturition is about May, and at that season the hinds are very cunning in concealing and tending, and exceedingly courageous in defending their young, which are exposed to many enemies. The "calf" (as the fawn is called by gamekeepers) never quits the dam during the whole summer; and in winter, the hind, together with all the males under a year old, assemble in herds, which are more or less numerous in proportion to the mildness or severity of the season. At the approach of spring they separate, none but those of the age of one year remaining associated. Stag-hunting, as carried on in the Highlands, is a sport capable of rousing all the manly ardor and energy of youth and manhood. The beauty, graceful and magnificent bearing of the animal, his sagacity in evading the stratagems of the hunter, or deer stalker, and his courage when at bay, add greatly to the pleasure of the chase. When the stag stands at bay, his effort is to do so in a river or lake, where

RED EAGLE—RED LINE MAP

he has a great advantage over the dogs, for he firmly stands and holds his position, whilst they swim powerless around him. On land, even, a stag at bay has great advantage over the hounds, who exhaust themselves with their clamor, while he is in a comparative state of rest, and recovers his wind. In stalking deer, the animal is generally shot; but if he is only wounded, and has power to fly, then the dogs are slipped to the pursuit. But, in olden times, the chief reliance for pulling and killing the deer was in the dogs; and the fleetness and courage of their hounds were the pride of nobles and kings.

At the present day another sort of stag hunting takes place near Windsor Castle, and in some other parts of England. In this sport, which is contemptuously regarded by many persons, a captive stag is carried in a covered cart to the place where the chase is to occur, and then turned loose. After a brief interval, called giving the deer "law," a pack of hounds is sent upon his trail, and if the stag has spirit enough to run, the hunters following on horseback have a lively chase across the country, at the end of which the deer is retaken, unharmed if possible, and saved to run another day. This is a rather tame tradition of the ancient sport.

From the most remote periods, the stag has been the favorite object of the chase; and the severe forest laws of the earlier Norman monarchs sufficiently attest the importance which they attached to the sport. The afforesting of vast tracts of country, by which not only single cottages were destroyed, but whole villages swept away, and churches desecrated and demolished, was the fertile source of misery to the poorer inhabitants, and of injustice to the ancient proprietors of the soil; and the cruel inflictions of the oppressive laws which were enacted to preserve the deer, increased tenfold the curse arising from this tyrannical passion for the chase,—for it was a crime less severely penal to kill a man than to destroy or take a deer.

The ancient customs and laws of 'Venerie,' that science which our simple ancestors looked upon as one of the first accomplishments of the high-bred noble, and a knowledge of which was essential to his education, were formal and technical to an extreme degree. A few of the terms, betokening the different ages of the stag and hind, are still retained, though somewhat altered. The young of either sex is called a "calf"; after a few months the male becomes distinguished by the growth of the bossets, or frontal protuberances, on which the horns are afterward developed, which during the first year are merely rounded knobs, whence he takes the name "knobber." In the second year they are longer and pointed, and are called dags, and the animal has now the name of "brocket." In the third year, the first, or brow antler, has made its appearance, and the deer becomes a "spayad." In the fourth, the bezantler is added, and he is then termed a "stag-gard." He is a "stag" in the fifth year, when the third antler, or royal, appears; and in the sixth, the commencement of the sur-royal, or crown, is formed; when he takes the name of "hart," which name he retains through life. At this time he is called a "stag of ten," probably because the branches, including the sur-

royal, frequently amount to that number. After the seventh year he is said to be croched, or palmed, or crowned, according to the number of branches composing the sur-royal. The female is a "calf" in the first year, a "brocket's sister" in the second and third, and ever afterward, a "hind."

See DEER, and consult authorities there cited.

Red Eagle, Order of the. See ORDERS, ROYAL.

Red-eyed Vireo. See VIREO.

Red Game, or Grouse. See GROUSE.

Red Gum-tree, one of the Australian Eucalypti (*Eucalyptus resinifera*), yielding a gum-resin valued for medicinal uses. (See EUCALYPTUS.) Also the North American liquidambar (q.v.).

Red Horse, a fish. See SUCKER.

Red Jacket, American Indian, chief of the Senecas: b. Old Castle on Seneca Lake, about 1751; d. Seneca Reservation 30 Jan. 1830. His Indian name was Sagoyewatha; he was called Red Jacket on account of the scarlet jacket he always wore, which had been given him by a British officer. He was one of his tribe who served with the British during the Revolutionary War; and was noted as an orator. He became widely known through his attitude toward the treaty of Fort Stanwix in 1784; a council had been called to negotiate between the United States and the Six Nations for the cession of lands, and on the occasion he spoke eloquently against the proposed treaty, but without avail. It was shortly after this that he was elected chief of the Senecas. In 1792 on the occasion of the signing of a treaty of peace between the United States and the Six Nations, Red Jacket had an interview with General Washington, who gave him a silver medal which he always wore afterward. In 1810 he gave information to the agent of the government of the attempt made by Tecumseh to draw the Senecas into the western combination; and in the war with England of 1812 he offered the service of his tribe to the United States, and proved his bravery in several skirmishes. The latter years of his life were passed on the Seneca Reservation; he became very intemperate, and was at one time deposed from the chieftainship on that account. He always opposed the advance of civilization, the missionaries, and the work of education among his people. Consult the 'Life' by W. L. Stone.

Red Jacket, Mich., village in Houghton County; on the Chicago, M. & St. P., the Chicago & N., the Mineral Range, and the Copper Range R.R.'s; about 15 miles north of Houghton. It is in the famous copper region in northern Michigan, near Lake Superior. Its industries are connected with the mining of copper and preparing it for market. Pop. (est.) 4,700.

Red Line Map, a map which attracted considerable interest about the time of the dispute between the United States and England over the boundary line between Canada and Maine. It was made by the Frenchman D'Anville in 1746. It had been sent to Vergennes, the French minister, by Franklin in 1782, and was discovered among the Paris archives by

RED MEN — RED RIVER CAMPAIGN

Jared Sparks. A strong red line drawn near the ridge, in which the Kennebec and Penobscot rivers rise, more than favored the English claims, respecting the northeast boundary of the United States. Sparks sent it to Webster, then Secretary of State, who was anxious lest the English should hear of it. It was used in a secret session of the Senate, and with the Maine commissioners to induce a ratification of the treaty, and was afterward made a ground of reproach against Webster by opponents of the treaty.

Red Men, Improved Order of. See IMPROVED ORDER OF RED MEN.

Red Oak, Iowa, city, county-seat of Montgomery County; on the Nishnabotona River, and on the Chicago, Burlington & Quincy railroad; about 48 miles southeast of Council Bluffs and 38 miles east of the Missouri River. It was founded in 1857. It is in a fertile agricultural and stock-raising region; and its industries are connected chiefly with farm products. The chief industrial establishments are flour mills, machine shops, creameries, lumber and brick yards, and stock yards. The city has 13 churches, six school houses, county court-house, municipal buildings, and several good business blocks. The three banks have a combined capital of \$200,000. Pop. (1890) 3,321; (1900) 4,355; (1910) 4,830.

Red River, a large river of the United States, the southernmost of the great tributaries of the Mississippi River. Its headwaters are in the northwestern part of Texas, on the eastern edge of the Llano Estacado, and it flows east-southeast, forming the boundary between Texas and the Indian Territory and the northeastern boundary of Texas, entering Arkansas at the southwest corner of the State. After entering Arkansas it turns south and pursues an exceedingly irregular course to Shreveport, La., where it again takes a southeast course to Avoyelles County, making a large northern curve in crossing this county, and entering the Mississippi River opposite the southwest corner of the State of Mississippi. The mouth of the Red River is about 340 miles from the mouth of the Mississippi River. The whole course is nearly 2,000 miles. The chief tributaries are the Washita, which joins it in Louisiana; and the False Washita and the Kiamich, both of which it receives in the Indian Territory. Much of its course is through rich prairies, with red soil which colors the water. About 100 miles above Natchitoches, which lies 100 miles above the mouth of the stream, commences a swampy expansion of the river called the Raft, 70 miles long and 20 miles to 30 miles wide, produced by the river dividing into a number of channels, sometimes shallow, which have been obstructed by fallen trees and other matter brought down by the stream. At great expense this obstruction has been cleared away so far as to admit the passage of steamboats. About four miles above Natchitoches the various channels again unite, soon, however, again to separate into numerous creeks and bayous. Above Shreveport was another such Raft, about 32 miles in length. In 1873 a channel was cut through, making this part of the river navigable, but constant care is exercised in removing the floating timber so as to keep the stream open.

In the upper part of its course it flows through lofty cañons whose perpendicular sides are from 300 to 800 feet in height. After leaving the cañons it enters the sandy lands, where the waters extend out to a shallow stream from 500 to 3,000 feet in width. Then as it enters the wooded country the stream becomes sluggish and spreads out for miles.

A peculiarity of the lower course of the river is the bayous which it sends out. Some of the bayous return to the main stream and others flow directly to the Gulf of Mexico. The Atchafalaya River originally left the Mississippi at a great bend below the mouth of the Red River; but the Mississippi has cut across the bend, forming Turnbull Island, and here the Red occupies the channel once the Mississippi, and flows south of the island, so that the head of the Atchafalaya is now in the Red River, from which it flows south to the Gulf. The Mississippi receives the flood much earlier than the Red River, and at that time, the Mississippi flood waters flow back past Turnbull Island and down the Atchafalaya. The flood plain of the Red River in Louisiana extends along the river until it is merged into the flood plain of the Mississippi at the mouth of the Black River. This plain is from 10 to 20 miles wide, and is known as the Red River bottoms. The plain is below the level of the river and is protected by levees. The river bed above Natchitoches has changed. Many years ago the river left the old bed and cut a new way for itself, a channel about 20 miles long. The new channel is called Bon Dieu River and the old channel is called Cane River. The government is improving the navigation of the Red River. Engineers are working to force all the waters of the Red River into the Mississippi; thus cutting off Atchafalaya. The river is navigable for nearly 1,300 miles, and with its tributaries, over 2,000 miles. Small steamers can ascend almost to the Texas boundary at high water, and to Shreveport at all seasons except when the water is very low. Consult: Marcy, 'Exploration of the Red River of Louisiana.'

Red River, or **Song-Koi**, a river of Tongking, formed by the junction of the Leteen and Song-shai, the former rising in the Yun-nan province of China, the latter in Laos. It flows southeast, passes Hanoi, and after a course of about 700 miles falls by several mouths into the Gulf of Tongking. The river is navigable to Lao-kai, on the border of China and Tongking and along it the French are developing a trade with the Chinese.

Red River Campaign. In 1864 Gen. Banks, to reduce Texas, asked for reinforcements in order to take in rear the Confederate works at Galveston and the mouth of the Brazos; but Halleck advised operating by way of the Red River, capturing the Confederate depot and dockyard at Shreveport, and repossessing western Louisiana and Texas at a blow. The Mississippi squadron under Porter was to co-operate; the army must be back for the trans-Mississippi operations of spring and summer; but no movement could be made till the spring rains had raised the Red, with only four feet at low water and full of obstructions. The fleet left Vicksburg 10 March, and landed A. J. Smith's troops at Simsport on the 13th; Gen.

RED RIVER OF THE NORTH — RED SEA

Franklin had already come up and driven Gen. Dick Taylor from Fort De Russey guarding the stream; the fleet passed up without opposition; and on the 15th and 16th the forces met at Alexandria. But the Union movements were difficult of co-ordination; Banks did not arrive till the 26th, the rest of Franklin's corps on the 28th. Meantime the Confederates had strongly fortified Shreveport and placed several gunboats there. Banks, with Franklin, went by land to Natchitoches, routing a Confederate force at Cane River on the 28th; Smith's command went by the river in transports, to Grand Ecore, four miles below, arriving 3 April, the day after Banks. On the 8th and 9th Banks advanced by a road away from the river; the Confederates had laid a V-shaped ambush for him, and his command of 8,000 men was utterly routed, and would have been annihilated but for reinforcements from Franklin, 2,000 being killed or wounded (battle of Mansfield). Banks retreated; the next day the Confederates advanced, but were met by a counter-ambush of Franklin's, and one wing of their army was driven back with heavy loss. But the other wing was so successful that the Federals retreated that night and hurried on to Grand Ecore and finally to Alexandria, abandoning the campaign. Meantime the fleet was caught in the falling water of the Red, and would have fallen into the hands of the Confederates but for the engineering skill and resolution of Lieut.-Col. Joseph Bailey, who built a dam of stones and logs, which raised the river and floated all the vessels down with a narrow escape from destruction.

Banks' army in this campaign numbered 31,303; but after detaching two divisions sent to different points, he had a marching column of 25,736 officers and men of all arms. His losses, including those lost on the retreat from Alexandria, were 454 killed, 2,191 wounded, and 2,600 captured or missing, a total of 5,244. Taylor's Confederate army numbered 11,000, and its total losses in the campaign were 3,976 in killed, wounded, and missing. See SABINE CROSS ROADS.

JOSEPH T. DERRY,
Author of 'History of Georgia.'

Red River of the North, a stream which has its source among the lakes in the west central part of Minnesota. It first flows south and southwest, then west to the boundary between Minnesota and North Dakota, where it turns north and forms the boundary between the States mentioned. It enters Canada in the province of Manitoba and flows into Lake Winnipeg. Its source is about 1,600 feet above sea-level and its mouth 710 feet. It is nearly 700 miles long, the greater part of its course is in the United States. Its drainage area is about 43,500 square miles, three fourths of which is in the United States. It is navigable almost to the source. The river and its tributaries have in many parts of the plain cut channels through the clay from 20 to 30 feet deep. The Red River is connected with the Mississippi through its southern branch, Lake Traverse, and the Minnesota River. At high water small steamers can pass from the Red River to the Mississippi. It is connected with Hudson Bay by means of Lake Winnipeg. A number of small rivers enter the Red River from Minnesota and North Dakota. The largest tributaries from North

Dakota are Sheyenne and Pembina. The latter river has its rise in Manitoba. The chief tributary it receives in Manitoba is Assiniboine.

The Red River flows through a productive agricultural region, famous for the quantity and quality of its wheat. The greater part of the basin of this river has been twice submerged beneath the sea, and it was covered with an extensive glacial drift which left an immense lake, now called Lake Agassiz (q.v.), that had an outlet to the Mississippi River. The beaches are still well defined, even those showing the gradual contraction of the lake. The lakes of Manitoba are the remains of this vast lake. The deposits made by means of ice and water have made the Red River Valley an exceedingly fertile region.

Red River Settlement, Canada, founded in 1812 by the Earl of Selkirk, on the banks of the Red River, and since 1870 forming part of the province of Manitoba (q.v.).

Red Rover, The, a sea tale by James Fenimore Cooper, published in 1828.

Red Russians. See RUTHENIANS.

Red Sandstone, an obsolete term in stratigraphical geology, used to designate a group of formations of which a red sandstone of various shades was characteristic. These sandstones, however, were later found to belong to two series, a lower one, the Old Red Sandstone (q.v.), now generally known as Devonian, and an upper one, the New Red Sandstone (q.v.), separated from each other by the formations of the Carboniferous Period (q.v.).

Red Scale, an insect affecting the orange (q.v.). See also SCALE-INSECTS.

Red Sea, or **Arabian Gulf** (ancient, *Mare Rubrum*, *Mare Erythraum*, or *Sinus Arabicus*; Arabic, *Bahr-el-Hejaz*), a branch of the Indian Ocean, extending from the Strait of Bab-el-Mandeb, in a north-northwest direction between Arabia on the east, and Abyssinia, Nubia, and Egypt on the west, and connected with the Mediterranean on the north by the canal, about 100 miles long, across the Isthmus of Suez. The Red Sea is a comparatively narrow expanse, 1,450 miles long with a maximum breadth on the tropic of Cancer of 200 miles and a general average of about 180 miles, but diminishing gradually at its south and north extremities; at the former, across the strait it has a width of only 14½ miles, further subdivided by the island of Perim into two channels, a larger on the east, of 11 miles, and a less on the west, of 1½ miles, and forking at the latter into two branches, the one of which, forming the Gulf of Akaba, penetrates north by east into Arabia for about 100 miles, with an average breadth of about 15 miles; while the other, forming the Gulf of Suez, follows the general direction of the sea, and penetrates between Arabia and Egypt for about 200 miles, with an average breadth of about 20 miles. In the fork between these two branches is the celebrated Mount Sinai, or Jebel Musa (Mount of Moses). To the Biblical student the Red Sea possesses considerable interest, from the account of its miraculous passage by the children of Israel when journeying from Egypt. The place at which they crossed the sea was the Gulf of Suez at its northern extremity, but opinions differ as to the exact point of transit,

RED SHIRTS—RED SUNSETS

some maintaining that it was in the neighborhood of the town of Suez, and others that it was about 18 miles farther south, at the mouth of the Wady Tuarik.

The climate is tropical and depressing; both shores of the Red Sea east and west consist generally of a low tract, mostly sandy, though sometimes swampy, varying in width from 10 to 30 miles, and suddenly terminated by the abutments of a lofty table-land of 3,000 feet to 6,000 feet high. The Red Sea may thus be considered as occupying the bottom of an immense longitudinal valley, which probably at one time extended between the table-lands without interruption, but has since been partially filled up by coral-workings, which, extending in parallel lines at a short distance from either coast, have subdivided the sea into three different channels, and have also studded its shores with numerous small islands. In the main channel the depth reaches in one place 1,054 fathoms, but diminishes toward the extremities, where the depth in general does not exceed from 40 to 50 fathoms.

In the Gulf of Suez, which in earlier times is supposed to have extended considerably farther north, this depth gradually decreases to 30 fathoms, and still continues to shoal, till at the harbor of Suez it amounts to only three fathoms; in the Gulf of Akaba, on the contrary, the depth of the main channel is fully maintained, and in some places even exceeded. The currents of the Red Sea are the result of prevailing winds. These winds, whether proceeding either directly north or south, affect only the main body of the sea, and leave a considerable belt along the coasts subject to alternations of land and sea breezes, and not unfrequently to sudden squalls. The chief dangers to navigation arise from the number of shallow reefs, of the presence of which no intimation is given, as the sea never breaks upon them. This absence of breakers is accounted for by the porous nature of the coral, which offers so little resistance that the sea diffuses through it without commotion, as if it were passing through a sieve. The principal harbors of the Red Sea are, on the African coast, Suez, Kosseir, Suakin, and Massowa; and on the Arabian coast, Jedda (the port of Mecca), Hodeida, and Mocha. The trade from shore to shore is not of much importance, consisting chiefly of the transport of pilgrims and some grain from Egypt; but the trade up and down the sea, between Europe and the East Indies, has become very large since the construction of the great ship canal across the Isthmus of Suez.

A telegraphic cable enters the Red Sea at Suez, passes down to Kosseir on its western shore, thence to Suakin on the same side, about lat. 19° 10' N., and then proceeds in a south-southeastern direction close to the island of Perim, and out into the Indian Ocean by the Strait of Bab-el-Mandeb, and arrives at Aden (q.v.).

Red Shirts, the name given to an organization in North Carolina, whose object was to establish and maintain white supremacy in that State, and keep the negroes under. It flourished in the reconstruction period after the Civil War. The members wore red shirts.

Red-shouldered Hawk, a large American buzzard-hawk (*Buteo lineatus*), known popu-

larly as one of the hen-hawks (q.v.), and common over most of North America; but western examples differ from the eastern ones and are called the red-bellied hawk (variety *elegans*). It is most numerous south of the Great Lakes in winter, by reason of the accession of northern migrants. It is of large size and distinguished by the rufous tinge of the head, neck, and shoulders, and plumage generally, the breast with shaft-streaks of blackish, and the tail clear brownish-black, crossed with six sharply defined narrow bands of white. The young are darker and more obscurely marked. The habits of this bird are much like those of its congeners, the red-tail, and broadwing. They may be seen at all seasons "sweeping in graceful curves over the country, rising and falling in spirals, unless after noting prey, when they sometimes dart down hundreds of yards in a very few seconds. Although they feed much on birds and rabbits, and are frequent visitors to the farmyard, they seem to have a special predilection for squirrels." They make their nests of sticks in the tops of tall trees, and very early in the spring four or five large, globular, heavily blotched eggs, are laid. Consult Fisher, 'Hawks and Owls of the United States' (1893).

Red Snapper, a fish. See SNAPPER.

Red Snow, the color of which is caused by minute organisms, vegetable or animal. Aristotle hinted at its existence; Saussure in 1760 discovered it on the St. Bernard, and Capt. Ross in 1819 brought specimens from the Arctic regions. He had found eight miles of cliffs, 600 feet high, colored by it, in many places to the depth of 12 feet, where the rock was reached. Capt. Parry and other Arctic explorers have since met with it abundantly.

Red Spider, a small, scarlet web-spinning mite (*Tetranychus telarius*), which damage the leaves of plants in greenhouses. They should be killed off by a kerosene emulsion spray.

Red Sorrel. See HIBISCUS.

Red Stone, Old Fort, a Pennsylvania structure which figured in the struggle between the French and English for mastery in the Ohio region. It was first a storehouse of the Ohio Company, was a rendezvous for the English when they gathered to advance against the French in 1754, and was burned by the French later in the conflict. At its ruins the leaders of the Whiskey Insurrection held a meeting in August 1794 to plan opposition to the whiskey tax.

Red Sunsets, brilliant phenomena which attracted attention in North America and other parts of the globe in the autumn of 1883 and for several succeeding months. A vivid red glow suffused the entire western sky, remaining for upward of an hour, when it would slowly fade away. This strange sight was first noticed in India, where, it is said, the sun assumed a distinct greenish tinge on nearing the horizon. In striving to account for these strange manifestations a number of solutions were offered, but the theory that met with greatest acceptance was that they emanated from volcanic dust and gaseous matter vomited by Krakatoa, in Sunda Straits. Calculations demonstrated the fact that the manifestations of the red glow coincided with the course which such vapors

RED TAPE — REDEMPTORISTS

would take on being wafted away by winds.

Red Tape, a term applied to unnecessary routine and formality in official affairs. It is derived from the fact that official documents were bound together by red ribbons or tapes. Dickens in 'Little Dorrit,' and Mark Twain, in one of his humorous sketches, have illustrated the working of red tape.

Red Water, (1) a disease of cattle. See RINDERPEST. (2) A marine worm of flagellate protozoa, class *Mastigophora*, order *Dinoflagellata*, infecting harbor waters, destroying fish and molluscs. Varies in color from yellow to reddish brown and is so called as it turns the water red when present.

Red Wing, Minn., city, county-seat of Goodhue County; on the Mississippi River, at the head of Lake Pepin, and on the Chicago, Great Western, the Chicago, M. & St. P., and the Chicago & N. R.R.'s; about 40 miles southeast of Saint Paul. It was settled in 1853, incorporated in 1854, and chartered in 1864. It is in a productive agricultural region in which are deposits of fire-clay. Red Wing is the commercial and industrial centre for a large part of Goodhue and Dakota counties. The chief manufacturing establishments are sewer-pipe works which employ about 450 persons; furniture factories, about 250 employees; lumber mills, 140 employees; stoneware works, 120; hat factory, 40; other manufactories, with about 130 employees. The prominent public buildings are the churches, schools, and several business blocks. The educational institutions are a State training school, Red Wing Seminary, Hague Synod Theological School, Lutheran Ladies' Seminary, high school, public and parish schools, a public library, and private school libraries. There are two hospitals. The three banks have a combined capital and surplus of \$375,000. The government is vested in a mayor and a council of nine members, elected biennially. Pop. (1890) 6,294; (1900) 7,525; (1910) 9,048. JOHN A. PARDEE,

Editor, 'Goodhue County News.'

Redan, a fortified work having two faces forming a salient angle in the direction from which an attack may be expected. It is open at the gorge. A double redan has a re-entering angle for mutual defense. The redan is the simplest field work, and is used for defending the avenues of approach to a village, bridge, or defile. In front of another field work, it is called a flèche. When flanks are added to the faces, the work becomes a detached bastion or lunette. The redan at Sebastopol in the Crimean war was the scene of stubborn conflict between the Russians and the English.

Redbird. See CARDINAL GROSEBEAK.

Redbreast, or Robin Redbreast, a familiar European warbler (*Erythacus rubecula*), which by its familiar habits has endeared itself to children, and has caused it to be protected and welcomed more than any other bird. The red breast of the male is the distinguishing feature of the species, but the females have duller colors. In Great Britain the redbreast is a permanent resident, but in more northern countries it is migratory, flying southward in winter. It also occurs in Asia Minor and in North Africa. The nest is made of moss and leaves,

and is lined internally with feathers. The eggs number five or six, and are white, spotted with pale brown.

These birds, in winter especially, become very bold and confident in habits, approaching doors and windows without fear, and soon learning even to know the hand which deals out crumbs and scraps of food to them during the inclement season. On the approach of the milder spring the redbreast returns to its native haunts and wilder state. During the breeding season these birds are very pugnacious, and they may attack and drive away all the smaller birds from the vicinity of the nest. The food in spring consists chiefly of insects, while in autumn fruits and seeds constitute the dietary. The song is sweet, but not specially remarkable, and continues during spring, summer, and autumn, often in rainy weather. In Germany it is termed *Thomas Gierdet*; and in Norway, *Peter Ronsmad*.

Redbuck. See DUIKER-BOK.

Redbud, a tree. See CERCIS.

Redcap, a variety of Hamburg fowls. See POULTRY.

Red'ding, Cal., city, county-seat of Shasta County; on the Sacramento River, and on the Southern Pacific railroad; about 172 miles north of Sacramento. It is in a mining and lumbering region, in which there are some excellent farms in the fertile valleys. The chief industrial establishments are lumber mills, machine shops, foundries, and tool shops. The shipment trade is chiefly in lumber and minerals. It has a well-built court house and a sanatorium. Pop. (1910) 3,090.

Redemption, in Christian theology, the liberation of sinners from the penalties of the violated divine law; it is effected through the expiating vicarious sacrifice of Christ upon the cross. In law, the freeing of an estate from mortgage, or the taking back of mortgaged property upon fulfilling the terms or conditions on which it was conveyed to the mortgagee. See EQUITY OF REDEMPTION.

Redemptioners, or Indentured Servants, emigrants to the American colonies who sold their services to planters or others for a term of years—four, five, or seven, according to the contract—after the completion of which they acquired their liberty with a grant of land. There were redemptioners in the first colony founded in Virginia; the system was introduced in Massachusetts in 1631 and later in Maryland, New York, Connecticut, and Pennsylvania. With these indentured servants were brought in many persons who came not of their free will but were kidnapped and held in servitude. See VILLEINS.

Redemptionists. See TRINITARIANS.

Redemptorist'stine Nuns, or Order of the Most Holy Redeemer, a religious order of women in the Roman Catholic Church, founded in 1732 by St. Alfonso de Liguori. They are strictly cloistered, leading the contemplative life, and by their prayers assisting the missionary priests of the order of Redemptorists (q.v.); they are subject to the jurisdiction of the ordinary of their place of residence.

Redemp'torists, members of the Congregation of the Most Holy Redeemer, an institute

of missionary priests in the Roman Catholic Church, founded in 1732 by St. Alfonso de Liguori; in some countries they are known as Liguorians. The institute received the approval of Benedict XIV. in 1749. The members, in addition to the three perpetual vows of poverty, chastity, and obedience common to all monastic and semi-monastic bodies, bind themselves by a vow of perseverance in the institute until death: by their vow of poverty they are bound to refuse all church benefices, offices, and dignities outside of their congregation. Their main occupation is the apostolic ministry in conducting "retreats" and "missions" to all classes, with preference for such as are most neglected or who come least under the ordinary ministrations of the Church. The Congregation has establishments in various countries of continental Europe and many in the British isles. Their first house in the United States was founded in 1832 at Detroit: they have now houses in many of the principal cities.

Redeye, the name of two or more common fresh-water fishes: (1) the rockbass or goggle-eye (*Ambloplites rupestris*) (see BASS); (2) in England the rudd, a reddish roach-like fish (*Leuciscus erythrophthalmus*), sometimes two pounds in weight, and highly esteemed by anglers both in Great Britain and on the Continent.

Redfield, Isaac Fletcher, American jurist: b. Wethersfield, Vt., 10 April 1804; d. Charlestown, Mass., 23 March 1876. He was graduated from Dartmouth College in 1825, admitted to the bar and engaged in law practice. He was attorney-general for Orleans County, Vt., in 1832-5, judge of the Vermont supreme court in 1835-52, chief justice in 1852-60, and in 1857-61 occupied the chair of jurisprudence at Dartmouth. He removed to Boston in 1861, and in 1867-9 was special counsel in Europe for the United States. He was editor for New England of the 'American Law Register' and published: 'Law of Railways' (1857); 'Law of Wills' (1864-70); 'Leading American Railway Cases' (1870); etc.

Redfield, William Charles, American scientist: b. Middletown, Conn., 25 March 1789; d. New York 12 Feb. 1857. In 1803 he was apprenticed to a mechanic at Upper Middletown (now Cromwell), in 1811 set up for himself at Middletown as a mechanic and small merchant, and in 1821 began his study of the subject of Atlantic gales by observations of the region in eastern Connecticut and western Massachusetts devastated by the storm of 3 September, long known as the "great September gale." By his investigation of the course and direction of prostrated objects, he became convinced that the storm was a progressive whirlwind. The perfecting of his theory of storms became his chief object. In 1831 he began the publication in the 'American Journal of Science' of a series of articles on the laws of storms; and in 1834, in an article in the same journal on 'Hurricanes of the West Indies' gave a complete synopsis of the main points of his theory as developed by a more extensive analysis of observed phenomena. His views, known as the "rotary theory of storms," were accepted after some slight opposition; and Redfield, by his explanation of the mechanism of extended hur-

ricanes became one of the principal contributors to a scientific knowledge of the earth's atmosphere. He wrote also on geography and geology. As a naval engineer he devised the system of "safety barges," by which passenger service via the Hudson between New York and Albany was conducted by means of a passenger boat drawn by two steamers at such a distance as to avoid danger of explosions, the frequent occurrence of which had caused general terror. Thus originated the idea of tow-boats for the conveyance of freight. Redfield was also prominently interested in railway construction. A list of his published papers, from 1829 to 1857, includes 62 titles.

Redfield, S. D., city, county-seat of Spink County; on the Chicago, M. & St. P. and the Chicago & N. R.R.'s; about 35 miles south of Aberdeen. It is an agricultural and stock-raising region. It has a State Institution for the Feeble-Minded and the Redfield College, opened in 1887 under the auspices of the Congregationalists. Pop. (1910) 1,431.

Redfin. See RED-HORSE; SHINER.

Redfish, the name of several fishes notable for their color: (1) In Alaska, the salmon more familiarly known by its name "blueback" (q.v.) in the Columbia River Valley; also called redfish about the lakes of northern Idaho. (2) On the California coast, a gaudily tinted wrasse (*Pimelometopon pulcher*), related to the eastern tautog, which reaches a weight of 12 or 15 pounds, and is taken in large numbers in the kelp offshore with hook and line. The Chinese salt and dry them. (3) The rose-fish (q.v.) of the Atlantic coast. (4) The red drum. See DRUMFISH.

Redgauntlet, rēd-gānt'lēt, a novel by Sir Walter Scott, published in 1824. Sir Alberick Redgauntlet, ardently espousing the cause of the Young Pretender in 1745, pays for his enthusiasm with his life. His widow, ascribing her bereavement to the politics of the Redgauntlets, desires to rear her children in allegiance to the reigning dynasty. Her efforts prove ineffectual and the tale is concerned with the plots to enthrone the Chevalier, into which young Redgauntlet is hurried by his uncle, an ardent Jacobite. Though showing haste, the story does not flag in interest, and even the minor characters—notably Peter Peebles, the crazy litigant, Wandering Willie, the vagabond fiddler, and Nanty Ewart, the smuggler—are living and individual.

Redgrave, Richard, English painter: b. Pimlico, London, 30 April 1804; d. London 14 Dec. 1888. After studying at the Academy, he was elected an A.R.A. in 1840, an R.A. in 1851. From 1847 he took a prominent part in art instruction, and in 1857 was appointed inspector general of art schools, which office, with that of surveyor of the royal pictures, he resigned in 1880. His principal pictures include 'Gulliver on the Farmer's Table' (1837); 'The Daughter of the Reduced Gentleman' (1840); 'The Return of Olivia'; and 'Country Cousins.' He wrote, with his brother, 'A Century of English Painters' (1866), and edited several valuable catalogues.

Redhead, a duck (*Aythya americana*), related to the pochard and canvas-back (qq.v.). From the latter the redhead may be readily

distinguished by its much shorter, broader, more strongly hooked bill, and brighter chestnut head, though it is frequently sold to the uninitiated as the more expensive canvas-back, to which it is little inferior in flavor. It is found in North America generally, breeds from the northern tier of States to high latitudes, and winters in Chesapeake Bay and southward. The nest is built of reeds, etc., with a lining of down and either on the ground or on a platform of reeds in the water; the seven or eight eggs are buff-colored and unmarked. Eastwardly this is one of the commonest species of ducks and congregates in great numbers in the sounds and estuaries of the Atlantic coast, consorting with canvas-backs, scaups, and other species of generally similar habits. It feeds on various aquatic animals, but more particularly on water celery and other aquatic plants. In the interior about the Great Lakes and elsewhere, these birds usually appear in flocks for a short time during the migrations and are said to visit the woods for the purpose of feeding on acorns and other mast like the wood-duck. The redhead is perhaps the best known and generally appreciated by gunners of all our ducks, but there is nothing especially distinctive of the method of its pursuit. Consult: Grinnell, 'American Duck Shooting' (1901); Job, 'Among the Waterfowl' (1902).

Reding, Aloys von, Swiss patriot: b. Schwyz, Switzerland, 6 March 1765; d. there 5 Feb. 1818. He became captain-general of his native canton in 1788, and defeated the French republicans at Morgarten Pass in 1798. In 1802 he founded a league in the eastern part of Switzerland with the purpose of re-establishing the old federal constitution, but was thwarted by French interference. In 1803 and in 1809 he was elected chief magistrate of Schwyz.

Redlands, rēd'landz, Cal., city in San Bernardino County; on the San Bernardino & R., the Atchison, T. & S. F., and the Southern Pacific R.R.'s; about 65 miles east of Los Angeles. It was settled in 1881 and in 1888 was incorporated. It is on the foothills of the San Bernardino Mountains, in a region famous for its scenic beauty. It is in a fruit section noted for its oranges. Fire-clay is found in the vicinity. The principal manufactures are clay and lumber products; and the trade is chiefly in oranges, raisins, and other fruits, wheat, barley, brick, lumber, and building stone. It has Saint Ursula's Academy, a Union High School, public and parish schools, and the A. K. Smiley Library. Two parks add to the attractions of the city. The government is vested in a board of trustees. They hold office four years. Pop. (1910) 10,449.

Redleg, one of the best known of Old World partridges (*Caccabis rufa*), which is especially numerous in France, where it is the principal object of sport in the autumn. It has been introduced into England, but is not much liked because slow to fly, running speedily before the dog and so puzzling both the dog and the gunner trained to the different behavior of the British gray partridge. Several other species of the genus share the name, as the Barbary partridge (*C. petrosa*) of North Africa, the chukar (*C. chukar*) of India, etc. See PARTRIDGE.

Redmond, rēd'mōnd, John Edward, Irish political leader: b. Dublin 1851. He was educated at Trinity College, Dublin, studied law and was admitted to the bar. In 1876 he was elected a member of the House of Commons, and later held a position in the vote office. In the House he became a "whip" for the Irish party, and was one of the most active supporters of Parnell in his organization of the Irish Nationalist party. He made several trips to the United States and Canada in behalf of the Nationalists. When the party was divided over the question of the continuance of Parnell's leadership, he supported Parnell. In 1900, when the factions were united, he was made the leader of the united party, which he has effectively organized. He is both a skilled parliamentarian and an eloquent and forceful orator. He has published 'Historical and Political Addresses' (1898).

Redonda (rā-dōn'da) Island, West Indies, one of the Leeward group, situated between Nevis and Montserrat. Iron and alumina mines constitute its economic importance. It is a dependency of Antigua, and with Barbuda, another dependency, makes an area of 62 square miles. The total population of the three islands is about 35,000.

Redowa, rēd'ō-a, the name of a Bohemian dance introduced into England about 1846. The dance resembles the Polish mazurka. It was introduced into one of Meyerbeer's operas in 1849.

Red'path, James, journalist: b. Berwick-on-Tweed, England, 14 Aug. 1833; d. New York 10 Feb. 1891. He emigrated to Detroit, Mich., in 1848, and in 1852 removed to New York and became connected with the *Tribune*. In 1855 he went to Kansas and took part in the Free-Soil movement which he described for northern papers. Being already a confirmed anti-slavery advocate he traveled in the South for personal investigation of slavery conditions. With others he then undertook a scheme of colonization in Haiti and during his visits to the island was appointed by President Giffard commissioner of emigration in the United States. The breaking out of the Civil War put an end to his plans, and he entered the field as war correspondent principally attached to the armies of Gens. Sherman and Thomas. At the close of the war, he became superintendent of education in Charleston, S. C., reorganized its school system, and established colored schools and the Colored Orphan Asylum. In 1868 he established the Lyceum Bureau in Boston which arranged for the public appearance of lecturers and readers, which business was afterward purchased by Maj. J. B. Pond (q.v.). Resuming editorial work on the *Tribune*, he went to Ireland to report the famine of 1879-80. There he became interested in the Home Rule movement and devoted several years to its interests. In 1886 he became attached to the staff of 'The North American Review.' He assisted Jefferson Davis in preparing his history of the Southern Confederacy, and wrote, among other works, 'The Roving Editor, or Talks with Slaves in the Southern States' (1859); 'The Public Life of Captain John Brown' (1860); and 'Talks About Ireland' (1881).

REDPOLL—REDWOOD OF CALIFORNIA

Redpoll, a small linnet-like finch of the far northern regions, two or three species of which visit northern Europe, Canada, and the northern United States in winter. The males have the head and neck beautifully rose-red in hue.

Redroot. See CEANOTHUS.

Reds of the Midi, The, a story by Felix Gras (q.v.), published in 1896. It is a strong tale of the French Revolution. One Pascal Le Patine, in his old age, night after night, in the shoemaker's shop, tells the story of his youth when he joined the "Reds of the Midi" (the insurgents of southern France), went to Paris, and witnessed all the horrors of the Revolution. The prologue of the tale is pure autobiography, and many of the characters are drawn from life.

Redshank, or **Gambet**, a large migratory snipe-like sandpiper (*Totanus calidris*) of Europe and Asia, representative of a large group, the American species of which are called willets by gunners; its average length is about 11 or 12 inches; and its popular name is derived from the red color of the legs. The spotted redshank (*T. fuscus*) and the greenshank (*T. glottis*) are allied species.

Redstart, in the United States a small active migratory warbler of the genus *Setophaga*, especially *S. ruticila* of the eastern part of the country, whose colors are a charming contrast of black and orange-red in the male, the female being more nearly brown and yellow. It has a sharp, exclamatory, but pleasing spring song, and makes a pretty nest of bark-shreds, etc., in an orchard tree or garden bush. The European redstarts are small brownish birds, closely related to the redbreasts, but distinguished by a bright red tail. They construct nests chiefly among the ivy of ruined buildings, the eggs numbering five or six, and being of a greenish-blue color. The redstarts are active birds, feeding on fruits, seeds, and insects, which they pursue on the wing. The song is low, but sweet, and these birds are said to imitate very skilfully the notes of other feathered songsters.

Redtail, a common American hen-hawk (q.v.).

Redtop. See GRASSES IN THE UNITED STATES.

Red'way, Jacques Wardlaw, American geographer: b. Nashville, Tenn., May 1849. He was educated at the University of California and at Munich, Bavaria. He occupied the chair of physical geography and chemistry at the State Normal School of California, was engaged in mining engineering and exploring in California and Arizona in 1870-80, and later pursued geographical investigations in South America, Europe, and Asia. He has published: 'Manual of Geography' (1887); 'Manual of Physiography' (1900); 'New Basis of Geography' (1901); 'Commercial Geography' (1902); etc.

Redwing, a European thrush (*Turdus iliacus*), visiting Great Britain and southern Europe in winter, when they flock in the fields in search of insects and worms. The summer song is pleasing, but the winter notes are harsh and unmusical.

Red'wood, Boverton, English chemist: b. London 26 April 1846. He was educated at the University College School and at the Pharmaceutical Society of Great Britain. As an authority on the technology of petroleum he accompanied Sir Vivian Majendie on his tour of inspection to the petroleum districts of Europe and America. He is adviser on petroleum to the Home Office and is consulted as an authority in that field by different branches of the British government. He is a member of the leading English and American scientific societies, was a member of jury at the Paris Exposition in 1900 and appointed a member of the Royal Commission to the Saint Louis Exposition in 1904. He has published: 'Cantor Lectures on Petroleum' (1886); 'A Treatise on Petroleum' (1896); 'The Petroleum Lamp' (with J. H. Thomson, 1902); etc.

Redwood, the name of various sorts of wood, as an Indian dyewood, the produce of *Pterocarpus santalinus*; the wood of *Gordonia Hamatrylon*, the redwood of Jamaica; that of *Pterocarpus dalbergioides*, or Andaman wood; that of *Ceanothus colubrinus*, the redwood of the Bahamas; that of *Soymida febrifuga*, of which the bark is used in India for fevers. In the United States, *Sequoia sempervirens* of the Pacific coast. See REDWOOD OF CALIFORNIA.

Redwood of California, the great cypress-like forest tree (*Sequoia sempervirens*) of the Pacific coast. It is of the same genus with the big trees (*S. gigantea*), botanically described under SEQUOIA; the latter occurs in scattered groups on the west slope of the Sierra Nevada, while the redwood forms dense forests on the west slopes of the Coast Range, where it forms the most important timber resource of the State. The forests were thoroughly studied by the government Bureau of Forestry in 1902, whose report furnishes the following facts: The redwood is popularly thought to occupy a strip of country 10 to 30 miles wide, from the Oregon line to the Bay of Monterey, but these boundaries do not cover its actual distribution. Two thousand acres of redwood exist in Oregon along the Chetco River. South of the Chetco a continuous redwood belt begins, and increases its width from 10 miles, at Del Norte County, to 18 or 20 miles, and keeps on unbroken to southern Humboldt County. Here is a break, but in Mendocino County the belt becomes dense again, and widens out to 35 miles. South of that county the tree grows in isolated patches as far south as the Santa Lucia Mountains.

The climate and topography that have brought about this limited distribution of the redwood deserve attention. North and south along the coast, in nearly parallel ridges, lie the mountains of the Coast Range, steep and rising to altitudes of 1,000 to 2,000 feet. A few large rivers and many smaller streams cut through them to enter the sea, and along their courses in places are broad bottom lands and gentle slopes. West of the Coast Range the climate is even and moderate, with a range from just below freezing to 80° F., and a yearly average of from 50° to 60°. Snow lies on the tops of only the highest ridges. Thirty to 60 inches of rain falls in the autumn and winter, and in the summer sea fog bathes the coast. But east of

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the mountains, less than 50 miles from the sea, lie hot interior valleys, never visited by the fog, parched and rainless in the summer, and wet only occasionally by the winter rains—conditions too unfavorable to permit the growth of the redwood. The forest may be considered in two types,—the "slope" and the "flat." The common type is the "slope"—that is the growth on the steep sides of the Coast Range, which is a mixture of redwood, red fir, tanbark oak, and white fir, with an occasional madroña or hemlock. As the slopes become moderate, the altitude lower, the soil deeper, and the water supply better, the redwood steadily gains on the other kinds and the forest becomes denser, until on the rich flats and in the gulches the second type is developed; on the best redwood "flats" no other tree grows.

The redwood grows to a greater height than any other American tree, but in girth and in age it is exceeded by the big tree of the Sierras. On the slopes 225 feet is about the maximum height and 10 feet its greatest diameter, while on the flats, under better conditions, it grows to be 350 feet high, with a diameter of 20 feet, and occasional giants exceed this. Most of the redwoods cut are from 400 to 800 years old. After the tree has passed the age of 500 years it usually begins to die down from the top and to fall off in growth. The oldest tree scientifically examined began life 531 A.D. The tree, when normal, has a straight, slightly tapered bole, clear for more than 100 feet, and a crown of horizontal branches that may occupy from a third to a half of its total length. The roots strike downward at a sharp angle, and are so large and so numerous as to form a compact mass of wood, in shape like an inverted funnel. The bark of the tree offers such a remarkable resistance to fire that except under great heat it is not combustible. It is of a reddish-gray color, fibrous in texture, and gives to full-grown trees a fluted appearance. The tree, however, assumes many shapes.

The redwood requires little of the soil except that it be moist, and those trees in a gully or along a creek are larger than their neighbors on the ridges. It is, however, so dependent on moisture of the air that this factor mainly or wholly determines its distribution, and the eastern limits of the forest are determined by the distance inland to which the sea fogs may drift.

The enemies of the redwood are few, and it suffers from them less than other trees. "The wind," remarks Fisher, "can scarcely uproot it, insects seem to do it little harm, and fungi seldom affect it. Even fire, the great enemy of all trees, though it may occasionally kill whole stands of young redwood growth, is unable to penetrate the fireproof sheathing of shaggy bark with which the old trees protect themselves." A large area of redwood forest in Santa Cruz County has been reserved as a national forest-park.

Reproduction.—The redwood forest consists of a mixture of trees of widely varying type, and keeps itself stocked by reproduction under its own shade. Seeds grow up very seldom, the seed itself seeming to have little vitality and the opportunities for its germination being rarely present, because it demands plentiful light. Hence new growth is almost exclusively by suckers, which, supported and nourished by full-

grown roots and stems, thrive under shade in which seedlings would wither. They thus survive and grow slowly, with little or no sun, until an old tree falls, lets in the light and they shoot up in rings about the stump into strong young trees. In 30 years, under favorable conditions, trees will result 16 inches in diameter and 80 feet high; and it is certain that it will be profitable to hold cut-over redwood lands for future crops. This second-growth timber has not the density and fine quality of the original, but is useful for many purposes, and large quantities have already been utilized.

Quality of the Wood.—Redwood is fitted for many uses. In color it shades from light cherry to dark mahogany; its grain is usually straight, fine, and even; its weight is light; its consistency firm, yet soft. It is easily worked, takes a beautiful polish, and is the most durable of the coniferous woods of California. It resists decay so well that trees which have lain 500 years in the forest have been sent to the mill and sawed into lumber. It has no resin, and resists fire, a fact which has recommended it as material for house-building, especially in San Francisco. Insects seldom injure it, because of an acid element its lumber contains. In sea water, however, the marine teredo eats off redwood piling as readily as other timber. Redwood is used for all kinds of finishing and construction for shingles, railroad ties, electric-light poles, paving blocks, tanks, and pipe staves. As a tie its average life, under heavy traffic, is six to eight years; as shingles it will last as long as 40 years. The chief difficulty in working redwood lies in the seasoning process, to dry it thoroughly being a slow and difficult process.

Lumbering.—The cutting of redwood for market began about 1850, and has steadily increased since with the market demand and growth of means of transportation. Its use is mainly confined to the State, and the greatest demand is from the southern counties. Occasional cargoes are sent across the Pacific, but it is rarely sent East, on account of the expense of transportation. It has never been a business giving extravagant profits. Several hundred thousand acres have already been cut over. A large part of this area has been completely cleared and cultivated or used for pasture but much remains as wild brush, believed to be useless; but it is now known that ordinarily a profitable second growth will arise, so that the anticipated extinction of the tree is no longer to be feared.

Felling one of these enormous trees is an operation requiring great experience and skill on the part of the woodsman, who must cause the vast trunk to fall precisely where he intends it to lie, and must take care that it is not split or broken by the concussion, to prevent which a bed is smoothed and prepared for it. A platform is then erected surrounding the trunk from six to eight feet above the ground. With a saw an undercut is made through the trunk, not quite to the centre, and from the opposite side a crosscut is sawed, ending a foot or two above the undercut and leaving a section of solid lumber between. When the exact place where the tree is to fall is selected, the choppers ascend the platform and with axes hew out an angular-shaped piece having the undercut as a

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base. When this cut is made the second or crosscut is wedged till the tree topples over and falls to the ground, the solid section of the trunk, not pierced by the cuts, supporting the tree till the centre of gravity is passed, and then the mighty frame falls on its prepared bed almost intact.

The next operation is performed by the "ringers" and "peelers." Every 12 or 14 feet, as required, a ring is cut around the circumference of the bark, and afterward the peelers with crowbars and wedges "peel" the bark from the prostrate trunk. Finally all of the trees are stripped but surrounded with an immense accumulation of debris of bark and branches, which must be removed before the trunks can be sawed into suitable lengths for conveyance to the mill. The ground is cleared by fire, precaution being first taken to plug up the "splits" in the trunk with clay so that the fire may not reach the interior of the tree. A foggy day is chosen and a still one. Fire is started and in a short time the tract is burning with a fierce heat that quickly reduces the piles of bark and brush to ashes, and leaves an unobstructed field for the removal of the timber which has been scarcely charred by the intense heat to which it has been subjected.

The trunks as they lie are then sawed into stated lengths, and then follows the arduous task of conveying these enormously heavy sections to the railroad. Temporary skidways are laid down and roads constructed. Chutes down which the logs pass have to be planned, and on these, guided by the skilful woodsmen, the unwieldy logs at last reach their destination. The work is assisted by donkey engines on sleds, which are hauled to the top of the steep banks and into seemingly impossible situations.

In 1903, the yield of virgin redwoods on the northern flats was from 125,000 to 150,000 board feet per acre. About Humboldt Bay it was from 50,000 to 75,000 feet per acre; and on slopes like those in Sonoma County, from 20,000 to 30,000 feet. The amount of timber got out of a redwood forest is only a small proportion of what the stand contained. At least a quarter of the timber is destroyed in felling and in the burning that follows, and of what remains all the broken and misshapen logs are left on the ground.

Bibliography.—Consult: Fisher, 'Report on Redwood,' Bureau of Forestry (Washington, 1903); and authorities on California, especially Muir, and on forestry. See FORESTRY.

Reed, rēd, Andrew, English philanthropist: b. London 27 Nov. 1787; d. there 25 Feb. 1862. He was educated at Hackney College, London, ordained pastor of the Congregational Chapel at New Road, London, in 1811 and remained in this charge until 1861. He visited the United States in 1834 to study educational and religious systems and established in London the Orphan Asylum (1813), Infant Orphan Asylum (1827), Asylum for Idiots (1846), Royal Hospital for Incurables (1855), and an Asylum for Fatherless Children in Croydon. He published 'Visits to the American Churches' (1836); 'Advancement of Religion the Claim of the Times' (1847); etc. Consult 'Memoirs,' edited by his sons (1863).

Reed, SIR Charles, English politician and philanthropist, son of Andrew Reed (q.v.): b.

near Sonning, Berkshire, 20 June 1810; d. Tottenham, Middlesex, 25 March 1881. He amassed a large fortune in the typefounding business, took an active interest in the philanthropic works of his father, served in Parliament as member for Hackney in 1868-74, and was re-elected for Saint Ives in 1880. He was president chairman of the London School Board in 1873-81 and in 1874 he was knighted.

Reed, Charles Alfred Lee, American surgeon: b. Wolf Lake, Ind., 9 July 1856. He was educated at Miami University, Oxford, Ohio, and studied medicine at the Cincinnati College of Medicine and Surgery. He was professor of gynecology and abdominal surgery at the Cincinnati College of Medicine and Surgery 1882-95; became gynecologist at the Cincinnati Hospital in 1896; and was president of the American Medical Association in 1900-1. He has published various professional monographs and a 'Text Book of Gynecology' (1900).

Reed, SIR Edward James, English naval architect: b. Sheerness 20 Sept. 1830; d. 30 Nov. 1906. He was educated at the School of Mathematics and Naval Construction in Portsmouth, was at one time connected with Sheerness dockyard, and having become an authority on naval architecture, was appointed chief constructor to the navy, for which he designed a number of ironclads and other vessels. He resigned in 1870 on account of his objections to rigged sea-going turret ships which he found to be growing in favor. He sat in Parliament for the Pembroke boroughs 1874-80, for Cardiff in 1880-95, and again 1900-06. In 1886 he was a junior lord of the treasury under Mr. Gladstone. In 1878 he visited Japan on the invitation of the government of that country. He published: 'Japan, its History, Traditions, and Religions' (1880); 'The Stability of Ships' (1884); 'Modern Ships of War,' with Admiral Simpson (1888); 'Poems' (1902).

Reed, Elizabeth Armstrong, American author: b. Winthrop, Maine, 16 May 1842. She was married to H. V. Reed in 1860. She was chairman of the Woman's Congress of Philology in Chicago in 1893, and has been a member of several learned societies. She has published: 'The Bible Triumphant' (1866); 'Hindu Literature: or the Ancient Books of India' (1891); 'Persian Literature, Ancient and Modern' (1893); 'Primitive Buddhism, its Origin and Teachings' (1896); etc.

Reed, George Edward, American educator: b. Brownville, Maine, 21 March 1846. He was graduated from Wesleyan University, Middletown, Conn., in 1869 and after studying theology in Boston University, entered the New England Southern Conference in 1870. He filled important appointments in the Methodist denomination 1870-89 and in the year last named became president of Dickinson College, Carlisle, Pa.

Reed, Hugh T., American military officer: b. Richmond, Ind., 17 Aug. 1850. He was graduated from West Point in 1873 and served chiefly on frontier duty until 1881 when he was appointed inspector-general on the staff of Governor Porter of Indiana. He was retired for disability in 1889. He has published: 'A Calendar of the Dakota Nation' (1887); 'Cadet Regulations' (1881); 'Broom Tactics' (1883); etc.



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Reed, Joseph, American soldier and statesman: b. Trenton, N. J., 27 Aug. 1741; d. Philadelphia 5 March 1785. He was graduated from Princeton and spent two years studying law in the Middle Temple, London. He returned to Trenton and took up the practice of law, and in 1767 was appointed deputy secretary of New Jersey. In 1774 he was appointed a member of the committee of correspondence for Philadelphia and in 1775 was president of the 2d provincial convention held in Pennsylvania, and endeavored to defeat the intention of arming the province. His English connections through his marriage inclined him to a conciliatory view of the English position, though he opposed the principle of parliamentary taxation. On Washington's appointment to commander-in-chief, Reed became his military secretary. In 1776 he was made adjutant-general, but resigned the next year and refused the office of brigadier-general and also first chief justice of Pennsylvania, preferring to remain Washington's volunteer aide, without rank or pay. In September 1777 he was elected to the Continental Congress, but continued with the army and took part in many engagements. In 1778 he was made chairman of a Congressional committee to confer with Washington concerning the management of the ensuing campaign. In December 1778 he was chosen president of the Supreme Executive Council of Pennsylvania and continued in office for three years, during which time he was one of the founders of the University of Pennsylvania, and favored the doing away with the proprietary powers of the Penn family. After the English peace commissioners had failed to treat with Congress, attempts were made to bribe Reed together with other high officials. He replied: "I am not worth purchasing, but such as I am, the king of Great Britain is not rich enough to do it." In 1780 he was invested with extraordinary powers and was principally successful in quelling the dissatisfaction of the Pennsylvania troops in the army. Consult 'Life' by Henry Reed (1846); W. B. Reed, 'Life and Correspondence' (1847).

Reed, Myrtle, American author: b. Chicago, Ill., 27 Sept. 1874. She has published 'Love Letters of a Musician' (1899) which has been widely read; 'Later Love Letters of a Musician' (1900); 'The Spinster Book' (1901); 'Lavender and Old Lace' (1902).

Reed, Thomas Brackett, American statesman: b. Portland, Maine, 18 Oct. 1839; d. Washington, D. C., 7 Dec. 1902. He was graduated from Bowdoin College in 1860, winning the first prize in English composition. He then took up the study of law, went to California in 1863, and was admitted to the bar there. In 1864 he was appointed assistant paymaster in the United States Navy, and assigned to a gunboat patrolling the Tennessee, Cumberland and Mississippi rivers. On receiving his discharge from the navy, he returned to Portland and established a law practice. His interest in public affairs and ability as a speaker soon made him prominent in the Republican party in Maine, and in 1868 he was elected to the lower house of the State legislature, where he served two years. He then entered the State Senate, and before his term had expired, was elected attorney-general of Maine. From 1874 to 1877 he was city

solicitor of Portland, and in 1876 was elected to Congress and served there continuously until his resignation in 1899. He first attracted attention in April, 1878 by a speech in opposition to a bill to reimburse William and Mary College for losses sustained at the hands of the Federal troops during the War. From that time his readiness in debate, knowledge of parliamentary law, and marked executive ability made him a power in the House. In 1885-9, while the Republicans were in the minority, he was their acknowledged leader on the floor, and in 1889 was chosen Speaker of the House. The Republican majority was small, and the business of the House continually delayed by the "filibustering" course of the Democrats. Speaker Reed did not hesitate to enforce strict rulings against such tactics, and ordered the clerk to count as present all members actually in the House, whether they answered to the roll-call or not. This aroused the strongest opposition from the Democrats; his conduct was denounced as tyrannous and illegal, and the epithet of "Czar" applied to him. His rulings were, however, sustained by the House, and later by the decision of the Supreme Court; and in the next Congress, when the Democrats were again in power, he had the satisfaction of seeing his rules adopted by the party that had so violently denounced them. In 1895 and 1897, he was again elected speaker, and this time his conduct of the business of the House met with the approval of both parties. As Speaker, he had a powerful influence in constructing and guiding legislation, though his name is connected with no single important measure, and he raised that office to a position second only to that of the President of the United States. He was a consistent opponent of free silver, and was largely instrumental in defeating the free silver bill of 1890. He was also a strong advocate of the policy of protective tariff, but was opposed to the administration policy in regard to imperialism and the questions resulting from the Spanish War. To this fact his resignation from Congress in 1899 is sometimes attributed. In 1896 he was a prominent candidate for the presidency, and at the Republican National Convention received 84½ votes, being second to McKinley. After 1899 he was engaged in the practice of law in New York. He contributed frequently to the magazines, edited a series of volumes on oratory entitled 'Modern Eloquence,' and published 'Reed's Rules of Parliamentary Procedure.'

Reed, Walter, American military surgeon and bacteriologist: b. Harrisonburg, Rockingham County, Va., 1851; d. Washington, D. C., 23 Nov. 1902. He was graduated from the medical department of the University of Virginia and from the Bellevue Hospital Medical College of New York, and was made 1st lieutenant assistant-surgeon, U. S. A., 26 June 1875. His promotions were captain assistant-surgeon 26 June 1880, and major surgeon 4 Dec. 1903. In 1890-1, while stationed at Baltimore, he made particular study of bacteriology in the laboratory of Professor William Welch, of the Johns Hopkins University; and established a laboratory of his own, in which he gave instruction to the student-officers of the Army Medical School. As curator of the Army Medical Museum, at Washington, D. C. (from 1893), he continued his researches, and soon became

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known as one of the leading bacteriologists of the country. His ability was especially displayed in his investigations of the cause and progress of epidemic diseases. In 1898 he was made head of a board for the study of the epidemics of typhoid occurring among the troops collected for the Spanish-American war. After the war he made several voyages to Cuba, and was on duty at Havana, studying the diseases of the island, and more particularly yellow fever, as a member of a board for its investigation. After a series of brilliant experiments, he was able to announce that yellow fever is conveyed by a certain variety of mosquito (*Stegomyia fasciata*), individuals of which become infected by biting persons ill with the fever and by their bite introduce it into the blood of non-immunes. The United States military government at once proceeded to measures of extermination which banished the fever from Havana, where it had prevailed for three centuries. The Atlantic seaboard of the United States was also thereby freed from constant peril. This achievement must rank among the important triumphs of bacteriological science. Consult Keane, 'Scientific Work and Discoveries of the Late Major Walter Reed' (Senate Doc. 118).

Reed, William Bradford, American lawyer: b. Philadelphia 30 June 1806; d. New York 18 Feb. 1876. He was graduated from the University of Pennsylvania in 1825 and accompanied Joel R. Poinsett to Mexico as private secretary. Then taking up the practice of law, he became attorney-general of Pennsylvania in 1838. In 1850 he was appointed professor of American history at the University of Pennsylvania, and in 1857 became United States minister to China. The next year he negotiated the treaty with China which regulated commercial relations as well as made more secure the rights obtained by the previous treaty of 1844. Subsequent to his return to America in 1860 he settled in New York and corresponded for the *London Times* besides contributing to 'The American Quarterly Review' and the 'North American Review.' He engaged in a controversy with George Bancroft, concerning certain statements repeated by the historian to the effect that his grandfather, Joseph Reed, meditated abandoning the American cause and going over to the British. In this controversy Reed wrote 'President Reed of Pennsylvania, a reply to George Bancroft and Others' (1867). Bancroft responded with 'Joseph Reed, an historical Essay' (1867), to which Reed replied with 'A Rejoinder to Mr. Bancroft's Historical Essay' (1867). He published 'Life and Correspondence of Joseph Reed' (1847); 'Life of Esther de Berdt' (1853).

Reed, (1) in music, the sounding part of several instruments, such as the clarinet, bassoon, oboe, and bagpipe, so called from its being made from the outer layer of a reed (*Arundo sativa* or *donax*) found in the south of Europe. The name is also applied to the speaking part of the organ, though made of metal. Reeds are generally divided into two kinds—the beating reed, used in the organ, clarinet, etc., requiring to be placed upon a tube to produce a musical sound, and the free reed, used in instruments of the harmonium and concertina kind. (2) In weaving, an appurtenance of the loom, consisting

of two parallel bars set a few inches apart, and furnished with a number of parallel slips or reeds, called dents, between which the warp threads are passed. The reed is set in a swinging frame, called a lathe, lay, or batten. In the hand lathe, the bottom of the batten is furnished with a shelf, called the shuttle race, along which the shuttle is driven. The office of the reed is to beat the weft up to the web, and the force of the blow determines the compactness of the fabric.

Reed, Flue, and Stringed Instruments, Temperament, Tuning, and Voicing of.

Temperament.—The intervals of the perfect octave are divided naturally into 53 parts or commas, the successive sounds of the diatonic scale being separated by these commas into the following intervals:

C to D	9 commas	9
D " E	8 " "	17
E " F	5 " "	22
F " G	9 " "	31
G " A	8 " "	39
A " B	9 " "	48
B " C	5 " "	53

Nature's arbitrary division of the octave, into intervals of exact dimension, is not satisfactory, nor does it admit of an exact equalizing; the only possible approach to it being by the method known as the "even temperament," which method or principle was discovered and established by John Sebastian Bach, in the early part of the 18th century, who learned that certain intervals would bear being tuned sharp (in excess of) or flat (short of) perfect; the thirds and fourths being tuned sharp and the fifth tuned flat of perfect, thus distributing among all the 12 keys of the octave, the three commas or points by which the major tones exceeded the minor, thus rendering equal the five tones in the diatonic series. Previous to this time, it had been the custom to tune to perfect intervals, those keys having not over 3 sharps or flats and play in those keys only. The problem to be solved was to so divide the octave into 12 semitones by fixed sounds, that each one of the 12 sounds could be made the key note upon which a properly proportioned diatonic scale could be based, either in the major or minor form and a melodic or harmonic progression made possible through the whole 24 major and minor scales; so that from any one of these 12 notes, a uniform chromatic scale could be constructed, thus making possible, modulations of unlimited variety and beauty.

The method then of tempering the notes of keyed instruments, consists in arbitrarily adjusting the enharmonic diesis, that is, the distinction there is naturally between D sharp and E flat, G sharp and A flat, by tuning these notes too sharp for one and too flat for the other of these natural tones or intervals, and by making a similar compromise between the more minute discrepancies of the diatonic scale. Thus while no interval will be exactly true, yet none will be so adjusted as to shock the ear by false intonation, but rather add a color or quality to the tonality of the instrument, which, though harmonious, would otherwise be characterless.

Rule for Tempering Pianos and Organs.—Tune middle C to desired pitch, then tune F—fifth below—sharp of C, until between C and F, there result three beats in five seconds. Next

tune A-sharp—fourth above F-sharp of the latter, until there results one beat, each second. Next tune G—fourth below middle C—flat of C, by one beat a second; then tune D—fifth above—flat to G, by three beats in five seconds; A—fourth below—flat to D; E—fifth above—flat to A; B—fourth below—flat to E; F-sharp—fourth below—flat to B; C-sharp—fifth above—flat to F-sharp; G-sharp—fourth below—flat to C-sharp; D-sharp—fifth above—flat to G-sharp, which will make D-sharp as sharp of A-sharp, as the latter is sharp of the first F tuned.

In all the above intervals, the fifths beat three times in five seconds; the fourths beat once a second, or five times in five seconds. All the 12 notes, from F below middle C to first E above, have now been tuned; the temperament has been confined to the smallest possible compass to lessen the liability of errors, and if the first F above middle C is now tuned three beats in five seconds, flat of A-sharp below, it will be a perfect octave to the first F tuned.

Tuning.—The art, principle or act of so adjusting the intonations of keyed musical instruments as to make possible consecutive musical tones agreeable to the ear. The method varies according to the kind or character of the instrument. Where strings are used, as in pianofortes, harps, violins, violas, guitars, zithers, etc., tuning consists in adjusting the tension of the strings by turning the pins or pegs around which the strings are wound. In band and orchestral wind instruments, a crook or joint is used, sometimes called a slide, because it slides in and out to adjust the length of the column of air in the tube to the point where the desired pitch of the fundamental note is obtained.

In reed organs it depends upon the adjustment of the comparative weight, length and thickness of the reeds, and in pipe organs upon the length of the vibrating column of air in the flue pipes.

In the tuning of strings, the pitch is determined by the size, length and tension of the wire. In reed tuning the desired pitch is obtained by filing or scraping the reed; at the base or fixed end to flatten the tone and at the point or free end to sharpen it.

Organ pipes are tuned according to their construction. The large open flue wood pipes are lowered or flattened in pitch by being lengthened by a sliding cap or by a board fastened to the back, at the top, and is raised or sharpened in pitch by being shortened.

The large open metal flue pipes are tuned by cutting away or adding to the length, or by a slit in the back near the top, making two flaps to be opened or closed as required; closing them lowers the pitch, opening them raises it; the smaller metal pipes being tuned by the use of a conical horn, with which the tops of the pipes are contracted or expanded, as the pitch is to be lowered or raised respectively. Stopped metal pipes are tuned by a cap, raised or lowered as desired, and reed pipes by adjusting the wire which bears upon the reed, the raising or drawing up of the wire increasing the effective length of the reed and so flattening it and *vice versa*. In the tuning of pipe organs, the reed pipes are the last to be tuned, since

they are the most liable of all the pipes to become disarranged.

Voicing of Keyed Musical Instruments.—The voicing of organ pipes consists in the adjustment of their various parts, consisting of the mouth, throat, lips, languid and ears, the correct method of treatment having been learned by experience, many years ago and of late years demonstrated by mathematical calculations, and by the investigations of scientists.

The languid is that flat piece of the pipe which lies horizontally above the upper part of the foot, and it is against this languid, the "sheet of wind" is forced from the "wind way" below. Some of the pipes have the languids grooved upon their face, as one method of voicing, and some metal pipes are voiced by bending the ears, which are placed on either side of the mouth. Pipes once voiced at the factory seldom need any alteration.

The voicing of reeds in the common house organ is accomplished by giving the free end of the reed, a slight curl or circumflex, and this also causes the reed to speak or sound more promptly and with less pressure of wind.

The voicing of pianos consists in the stabling of the felt of which the hammers are made, by several needles fastened in a handle. The thrusts should be made directly toward the centre of the hammer and not through the top of the felt, from the sides. In the making of hammers, which is done by machinery, one entire set being covered with felt at a time, there is a variation as to hardness in the individual hammers, and voicing is relied upon to lighten up the felt, and give a uniform character of tone throughout the entire scale of the piano.

EDWARD QUINCY NORTON,
Author of 'Construction, Tuning and Care of the Pianoforte.'

Reed-bird. See BOBOLINK.

Reed Canary Grass, a grass of the genus *Phalaris*. See GRASSES IN THE UNITED STATES.

Reedbuck. See REITBOKS.

Reeder, Andrew Horatio, American politician, first governor of Kansas Territory: b. Easton, Pa., 6 Aug. 1807; d. there 5 July 1864. He practised law at Easton and was prominent Democratic politician when, in 1854, he was appointed by President Pierce the first governor of the newly formed territory of Kansas. Upon arriving at his post he at once rendered his position difficult by declaring his intention rigidly to put down the violence resulting from the conflict of the two parties respecting slavery. In the election of March 1855 more than three fourths of the votes cast were illegal, but the governor issued certificates of election to all claimants whose papers were regular and against whom no protests or official notice of frauds were presented. His action he defended as strictly legal and declared that any other would have been revolutionary, though he confessed to knowledge of the fraudulent voting. He was dismissed from office by the President and he returned to Lawrence to reside and to join forces with the Free-Soil movement. He was nominated by this party as territorial delegate to Congress. A legislature of the Free-State party formed under the instrument known as the Topeka Constitution elected him to the United States Senate in 1856.

But the election was refused ratification by Congress. President Lincoln appointed him a brigadier-general at the outbreak of the War, but considerations of age induced him to decline. Consult: Spring, 'Kansas' (1885); Robinson, 'The Kansas Conflict' (1892).

Reedfish, a crossopterygian ganoid fish (*Calamoichthys calabaricus*), which, with the bichir (q.v.) is the only survivor of a group prominent in Palæozoic time, which dwells in the sluggish reedy rivers of the Senegal coast of Africa, searching the mud of the bottom for prey.

Reef, the part of a sail comprehended between the top or bottom and a row of eyelet holes generally parallel thereto. The object of the reef is to reduce the surface of the sail in proportion to the increase of the wind; for which reason there are several reefs parallel to each other in the superior sails; thus the top-sails of ships are generally furnished with three reefs, and sometimes four; and there are always three or four reefs parallel to the foot or bottom of those main-sails and fore-sails which are extended upon booms. When a reef has to be taken in the sail is slightly lowered; the men climb out along the lower boom or yard, which they lean over, with their feet supported by the foot-ropes, fold the loose portion of the sail around the yard, and tie them up with the cords inserted in the eyelet-holes. As the operation of reefing is dangerous in stormy weather many ships are now fitted up with a patent apparatus by which sails may be reefed from the deck.

Reef also implies a chain of rocks lying near the surface of the water.

Reel, a revolving contrivance on which fibre, thread, cord, rope, fabric, etc., are wound, to form them into hanks or skeins, and for various other purposes; applied to:

In agriculture, a device having radial arms carrying horizontal slats, and rotated by gear or pulley connected with the axle of a harvester, for pressing backward and holding the stalks of grain in position for being severed by the knives. In angling, a skeleton barrel attached to the butt of a fishing rod, around which the inner end of the line is wound, and from which it is paid out as the fish runs off with the bait, and is gradually wound in again as his struggles become less violent, bringing him to land or to the landing net. In baking, a cylinder with radial arms rotating in a heated chamber, carrying pans in which loaves of bread are placed for baking in the reel-oven. In cotton machinery, a machine on which cotton is wound, making hanks of thread. In domestic industry, a spool or bobbin of wood on which cotton, thread, silk, etc., is wound for use in sewing.

Also the name of a lively rustic dance in which the couples sometimes swing or whirl round, and sometimes pass, forming the figure 8. In the United States, the Virginia reel is widely popular. Also the music for such a dance, generally written in common time, but sometimes in jig time of six quavers to a bar. The Scotch dance known as a reel is executed by two couples, the music for which is generally written in common time of four crotchets in a bar, but sometimes in jig time of six quavers.

Reem, in Scriptural zoology, *Bos primigenius*. In the Authorized Version the influence

of the Septuagint has prevailed, and the word is translated "unicorn," but erroneously, as the mention of two horns on one reem (Deut. xxxiii. 17) proves. The word unicorn has disappeared from the Revised Version, wild ox being substituted for it; but in Num. xxiii. 22, the alternative rendering ox-antelope (*Oryx leucoryx*) is given in the margin. The term is still a vernacular name among the Arabs of the Sahara for a gazelle (*Gazella loderi*).

Rees, rês, Abraham, English Presbyterian clergyman: b. Llanbrynmair, Wales, 1743; d. 9 June 1825. He prepared for the ministry at Hoxton Academy, where in his 19th year he was appointed mathematical tutor to the institution, and soon after resident tutor, in which capacity he continued upward of 22 years. He was pastor to the Presbyterian congregation of St. Thomas', Southwark, 1768-83, and of a congregation in the Old Jewry from 1783 till his death. In 1776 he undertook a revision and expansion of 'Chambers' Cyclopædia,' which he completed in 1785. The success of this work led him to a new undertaking, similar in its nature, 'The New Cyclopædia,' in 45 volumes (1802-20), republished at Philadelphia in 47 volumes.

Rees, John Krom, American educator: b. New York 27 Oct. 1851; d. there 9 March 1907. He was graduated from Columbia in 1872, and from the Columbia School of Mines in 1875. He filled the position of assistant professor of mathematics in the Columbia School of Mines 1873-6, and was professor of astronomy in Washington University, Saint Louis, 1876-81. He was director of the observatory and instructor in geodesy and practical astronomy in Columbia 1881-4 and from 1884 professor of astronomy there. He was president of the New York Academy of Sciences in 1894-6, was elected fellow of the Royal Astronomical Society of London; and in 1901 received the decoration of Chevalier of the Legion of Honor.

Reese, rês, Michael, Californian pioneer: b. Heinsforth, Bavaria, 1816; d. Germany 2 Aug. 1878. Apprenticed to a tanner he worked at his trade until he emigrated to the United States, and there after some reverses he established a jewelry business in which he was successful. In 1850 he went to California and began investing in San Francisco real estate. When the Fraser River excitement was at its height, Berri, a Swiss banker, disheartened as to the future of San Francisco, expressed to Reese his desire to part with his holdings. Reese having a firm belief in the coming importance of the city purchased Berri's property and thus laid the foundation of his great wealth. Among his benefactions was his gift to the University of California of the Lieber Library. The Michael Reese Hospital of Chicago, Ill., is his memorial, while his legacies to charities in the aggregate reached half a million dollars.

Reeve, rêv, Tapping, American jurist: b. Brook Haven, L. I., October 1744; d. Litchfield, Conn., 13 Dec. 1823. He was graduated from Princeton in 1763 and in 1767-70 was engaged as a tutor there. In 1772 he established a law practice at Litchfield, and during the war served as a recruiting officer and as a member of various committees of safety and defense. In 1784 he opened a law school at Litchfield which became justly famous and for years was without

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an American rival. He conducted it without assistance until 1795, when he became associated with James Gould, who succeeded him in 1820. He was a judge of the supreme court of Connecticut in 1798-1814, served as chief justice for a short time, and subsequently served a single term in each the legislature and the council, after which he declined to hold further office. He was a Federalist, a lawyer of high ability, and was the originator of the movement to secure to married women the legal right to dispose of their own property. He published: 'The Law of Baron and Femme; of Parent and Child; of Guardian and Ward; of Master and Servant,' etc. (1816), republished in numerous editions; and 'A Treatise on the Law of Descents' (1825).

Reeve, a bird. See RUFF.

Reeves, rēvz, Helen Mathers, English novelist: b. Misterton, Somerset, 26 Aug. 1853. In 1876 she was married to Henry Albert Reeves, a London surgeon. 'Comin' Through the Rye,' her first story (1875), was widely popular both in this country and her own, and among her later fictions are 'Cherry Ripe' (1877); 'As He Comes Up the Stair' (1878); 'My Lady Green Sleeves' (1879); 'The Sin of Hagar' (1896); 'Becky' (1900). Her style is pleasing and animated and the interest of her novels is well sustained.

Reeves, John Sims, English tenor singer: b. Woolwich, Kent, 26 Sept. 1818; d. Worthing, Sussex, 25 Oct. 1900. He studied music and, in 1832, became organist in the church of North Cray, Kent, and made his first appearance as a singer in 1839 on the Newcastle stage. He first sang in London in 1842, and having studied in Paris and Milan made his first appearance at the La Scala theatre of the latter city as Edgardo in Donizetti's opera 'Lucia di Lammermoor.' His voice was of wide compass and great beauty — mellow and powerful, capable of the tenderest pathos and of the most stirring martial appeal, but always controlled by genuine artistic feeling and knowledge. He was heard to most advantage in the concert hall and in oratorio parts, and in such pieces as 'Guy Mannering' he displayed considerable histrionic ability. He published 'Life and Recollections' (1888); and 'My Jubilee' (1899).

Referendum, a reference to the popular vote of the question whether a proposed measure shall become a law. American State constitutions, and amendments thereto, are adopted by popular vote, and special measures are sometimes submitted by legislative action to the decision of the electors. In some cantons of Switzerland a method resembling the referendum has been practiced since the 16th century. According to the Swiss federal constitution, all constitutional amendments must be ratified by the Swiss electorate before they become law. Other measures must be submitted to the popular vote, if demanded within 90 days after their publication by 30,000 voters, or by the governments of eight cantons. During the 17 years, 1874 to 1891, out of 149 laws, 27 were referred to the people; of these 15 were rejected. The referendum has worked so well that it has conquered all opposition to it, and it is now generally regarded as a check on hasty and class legislation. It will be observed that the

essence of it is that it submits to the people a single and clear issue upon which they may give their decision. There exists also an obligatory referendum in eight cantons, where every law and every expenditure beyond a fixed maximum must be submitted to the mass of the electors, and it is not necessary that a demand for this submission to the electors should be made.

In the United States the movement in favor of the referendum has been making slow but steady and non-partisan progress for more than 12 years. Inspired by the success of direct legislation in Europe, a number of political reformers in New Jersey organized the first referendum league in 1892. Although numerically a small body, and having but meagre funds at their command, the members of this organization continued to preach the doctrines of the new political reform, both by voice and pen, until, as the result of the agitation which they inaugurated, four States now have direct legislation sections incorporated in their constitutions. The first State to adopt the new method of legislation was South Dakota, which, in 1898, passed the necessary amendment to its constitution. In 1900 the people of Utah cast a similar vote, and they were followed by Oregon in 1902, and Missouri in 1904. In Oregon the adoption of this legislative reform aroused so much opposition that the enemies of the measure took the matter to court, where a minor judge declared the amendment unconstitutional on the ground that it was not in accord with the provisions of the Federal Constitution. This decision was not accepted by the friends of the reform, however, and the question was immediately taken to the Supreme Court of the State, where, by a strong and decisive judgment, the decision of the lower court was reversed and the constitutionality of the amendment was established for all time.

In 1897 the legislature of Nebraska passed a law permitting any city within the State to adopt direct legislation methods in the conduct of its affairs upon the vote of a majority of its citizens. In the same year Iowa extended the initiative to all questions of franchise excepting those of public ownership, and other States, especially throughout the West, have since passed laws which indicate the existence of a popular demand for direct legislation.

The greatest development in the direct legislation reform as applied to municipalities is also shown in the West, particularly along the Pacific coast. In 1892, Seattle, Wash., adopted the measure, and its example was quickly followed by Buckley, Wash., Alameda, Cal., Vallejo, Cal., and several other small cities. In 1900, San Francisco obtained it. Sacramento, Cal., followed, then Los Angeles, Cal., and Portland, Ore. East of the Rocky Mountains, Denver, Col., Minneapolis, Minn., Detroit, Mich., and Nashville, Tenn., are among the larger cities which have applied these methods to the extension of franchises, if not to other questions.

As applied to the United States, the exercise of the referendum means that no law, or, if adopted by a city, no ordinance, may go into effect until a specified time has elapsed, during which period, if a reasonable minority of the people petition for a referendum on that question, the law cannot become operative until after the following election, when a majority of the popular votes either ratifies or rejects it. The length of time which must elapse before the bills

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passed by the legislature take effect as laws is usually 60 days, while the percentage of voters which must sign the petition to secure a referendum varies from 5 per cent in South Dakota to 25 per cent in Washington. The latter percentage is so high, however, that the law has become practically inoperative.

In the general plan for direct legislation the referendum, by giving the people the veto power over bad laws, represents the negative side of the reform movement. The positive, or constructive side of direct legislation is the "initiative," by means of which a reasonable minority of the voters (the number ranging from 8 per cent in Oregon to 15 per cent in Los Angeles, Cal.) may file a petition for a law, or, when a city, an ordinance. Without reference to the existence of committees or any legislative bodies, that question must then go before the people for their judgment, and, if it is approved by a majority of the popular votes cast, it becomes a law. In other words, while the referendum gives the individual voter power to prevent the enactment of bad laws, the initiative gives him the power to suggest good laws and to see that they are enacted by his own vote.

The value of this "initiative" was shown in Oregon in June 1904, when the first State law ever actually enacted by the people, independent of any action on the part of the legislature, was adopted. This was a Direct Primary Law, a measure which had aroused much opposition among the professional politicians, but which, when brought before the people upon the petition of 3 per cent of the voters, was carried by a vote of more than 5 to 1. The Local Option Law, which had met with a long series of defeats at the hands of the legislature, was also passed, under the initiative, by a vote of nearly 4 to 1.

Although the "recall," or, as it was formerly termed, the "imperative mandate," has not been made a part of the direct legislation laws of many of the States and cities, not a few have taken advantage of the opportunity to incorporate it. The exercise of this "mandate," or "recall," gives the people power to vacate any public office at their will. If any public official has failed to do his duty, or has been guilty of any act that would stamp him as unworthy of the future confidence of the people, a reasonable minority of the voters may petition for his recall. An election must soon follow the filing of this petition, and, while the "recalled" official may stand for re-election, if he fails to secure a majority of the votes cast, the successful candidate serves the remainder of his term. As the "recall" is too powerful an instrument to be used except in extreme cases, the number of voters who must sign such a petition is usually placed as high as 25 per cent, the percentage required in Los Angeles, Cal., where, in 1904, one of the councilors of the city was recalled and a successor elected, this being the first time that an American public official has been ousted during his term of office and another appointed to take his place by the direct vote of the people.

Refining of Metals, in metallurgy, the last step in the purifying of gold, silver, tin, copper, lead, etc. The first processes in extracting metals from their ores are always more or less crude, and where they are desired in pure or nearly pure forms chemical or other means

must be resorted to in order to relieve them of the resulting impurities. See **METALLURGY**, **ASSAYING**, **GOLD**, **SILVER**, etc.

Reflecting Circle, in astronomy, etc., an instrument designed to measure angles by the reflection of light by means of plane mirrors of which it is the support. It differs from the sextant (q.v.) in that it is built upon a complete circle and not a part of it.

Reflecting Galvanometer, the most sensitive galvanometer yet invented, devised by Sir William Thomson for use in connection with the Atlantic submarine cables. A short needle is rigidly attached to a small concave mirror and suspended by a silk fibre in the centre of a vertical coil of small diameter. This mirror is adjusted by means of a directing magnet to throw the rays of a light (falling on the mirror through a hole having a fine wire stretched upright across it and placed just under the graduated scale opposite the mirror) back on the scale. An image of the wire is thus thrown on the scale, and the slightest motion of the needle and its mirror will produce a much greater motion of this image. Thus, as the current flows the one way or the other, the index will move to one side or the other.

Reflection. See **LIGHT**.

Reflector, the name of a device by which the rays proceeding from a luminous or heated object are thrown back or diverted in a given direction. The reflecting surface may be either plane or curved. In practice it is often made spherical or parabolic. The former does not bring the rays to a true focus, but is easily formed, and is consequently generally employed where extreme accuracy is not sought for. A mirror is a familiar example of a plane reflector. The material should be as smooth and highly polished as possible. Silver is the most perfectly reflecting substance known, absorbing but 9 per cent of the incident rays, while speculum metal absorbs 37 per cent. Glass itself, owing to its property of totally reflecting incident rays at a low angle, is used in certain cases.

Reflex Action, a non-voluntary reaction affecting a muscular apparatus in response to some kind of sensory stimulus. Such a reaction implies the traversing of the sensory stimulus to some nerve centre or centres in the brain, the medulla, or the spinal cord, and the setting free of a muscular response, general or local, to certain organs of the body, without the participation of willed conscious action, although consciousness of a reflex act performed may precede or accompany the act. Many of these reflexes are extremely intricate, so intricate in fact that certain philosophers have attempted to show that all life-processes are of the type of reflex actions. Many reflex actions, by reason of the fact that their muscular equivalent acts on blood-vessels, may increase or decrease glandular activity. Thus fright may destroy the ability of the stomach to digest. Dryness of the mouth is frequent as a result of certain forms of unconscious excitement, and many if not all of the emotions may be regarded essentially as intricate forms of vasomotor reflexes. Further reflexes are constantly operative and affect the normal metabolism of the skin or the bones, and still others are concerned in the general nervous equilibrium of the entire body—the so-

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called neuromuscular tone. See CONSCIOUSNESS; EMOTION; MUSCLE-SENSE; NERVOUS SYSTEM; TELEPATHY.

Reform Acts, a term applied to certain acts of the British Parliament by which the regulations as to the parliamentary representation of the people were altered, and especially to those of 1832, 1867, and 1884-5. In the third successful effort for parliamentary reform, that of 1884-5, the franchise and redistribution of seats constituted two distinct acts. The franchise bill received the royal assent on 6 Dec. 1884, and came into operation on 1 Jan. 1885. It established household and lodger franchise in the counties, introduced a service franchise, and made a uniform occupation franchise of \$50 rent both in counties and in boroughs in place of the three formerly existing. It left untouched the 40-shilling freeholders of inheritance, and conferred votes on copy-holders possessing land of greater value than \$25 annually.

The great feature of the reform in representation was the separation of populous boroughs and counties into divisions, each returning a single member. England has now 465 members, Wales 30, Scotland 72, and Ireland 103, the reduction from 105 occurring through the disfranchisement of Sligo and Cashel some years ago for corruption.

Reformation, The. The Reformation is that movement in the 16th century which resulted in the division of Western Christendom into the Roman Catholic and Protestant Churches. Its principles, as set forth by Protestant writers, were in brief as follows: The Word of God is the final authority on all religious questions and is superior to tradition, the Pope, and the decision of general councils; a sinner is justified by faith alone. That is, he cannot obtain salvation by any amount of good works which he may accomplish, but is forgiven and saved through his faith in the work of Christ, the good works then following as a result not as a means of his salvation; a third principle is the universal priesthood of believers. This means that no mediator is needed between man and God except Jesus Christ and that all believers have direct access to Him, and that this power is not delegated to an exclusive priesthood.

For the beginning of this movement we must go back of the 16th century into the later Middle Ages. (See PROTESTANTISM.) The immediate occasion of the Reformation movement was Luther's (q.v.) controversy over the preaching of the indulgences in Germany granted by Leo X. to all who should contribute alms to the building of St. Peter's Church in Rome. Luther posted his 95 famous theses on the church door at Wittenberg 31 Oct. 1517. In these he claimed that the pope could not remit penalties beyond what he had himself imposed and also that his power did not reach beyond this life. Greatly to Luther's surprise the news of the posting of the theses quickly spread over Germany, and he found many to agree with him, but he desired only to reform certain abuses within the church, not to break away from it. But the efforts to bring about an agreement through discussion only revealed that his principles would logically carry him beyond the church. He declared the papacy a human institution, that the Council of

Constance had erred in condemning Huss and that some of the fundamental teachings of the Roman Catholic Church were erroneous.

In 1520 Leo X. excommunicated Luther, who burned the bull of excommunication and a copy of the canon law, thus cutting himself off from the papacy. The new Emperor Charles V. called Luther before the Imperial Diet at Worms the next year. Luther refused to retract any of the statements in his books unless convinced by the Bible or reason. He was placed under the ban of the Empire, that is, he was declared an outlaw. On his way home from the Diet he was taken by friends to the Wartburg, a castle belonging to the Elector of Saxony, and here remained in hiding, but not in idleness, because he busied himself with the translation of the Bible into the German of the common people. While here, extremists at Wittenberg were attempting to introduce radical reforms, and Luther returned in spite of danger and in a few days brought them to moderation, thus saving the Reformation from failure. The Reformation continued to spread through the efforts of many of the leaders in Germany, who were friendly to it and through the inability of Charles V. to give his attention to its suppression because of foreign wars. The Peasants' war (q.v.), which broke out in 1525, was ascribed by many to the teachings and position of Luther. The peasants, risen in rebellion against their rulers, believed that the time had come to strike for liberty and believed that Luther would help them, but he was opposed to their taking up arms, and the rising was put down with the loss of thousands of lives. This cost Luther many adherents and others were alienated by his marriage to a former nun in the same year. At each succeeding Diet an effort was made to come to some decision on the religious questions, but in vain. The best that could be done was the decision in 1526 to leave the matter to a general council, and until that should convene each state should use its own discretion. At the Diet of Spires in 1529, at which the Roman Catholic party was in the majority, the further progress of the Reformation was prohibited. The reformers protested against this action and received the name of Protestants. At the Diet of Augsburg in the next year the Protestants presented their confession of faith drawn up by Melancthon, and since known as the Augsburg Confession. Reconciliation between the two parties seemed to be out of the question, and the Schmalkaldic war broke out, ending in the victory of the Protestants and the Peace of Augsburg in 1555, by which the prince was to decide what should be the religion of the people under him, with this reservation that if an ecclesiastical prince should become a Protestant he must surrender his see.

A parallel but independent religious movement was in progress in Switzerland, under the leadership of Ulrich Zwingli. Born at Wildhaus and educated at Vienna and Basel, he came under the influence of the Renaissance and became a zealous student of the Greek Testament. Like Luther, he protested against abuses in the Church, inveighed against indulgences and tried to introduce reforms without separating from the Church. He preached at Einsiedeln and later at Zürich, with much

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power and attracted attention by his exposition of the Scriptures. His influence over the city government was so great that in 1523 he procured an order that the clergy of the city should preach nothing but what they found in the Scriptures and that images should no longer be used in the churches nor the sacrifice of the mass be celebrated, and in the place of the Roman Catholic forms of worship a simpler form, and as Zwingli believed, one more in accordance with the teachings and example of Christ took its place. This suggests one of the differences between Luther and Zwingli. Luther desired to keep as much as he could of the forms, ceremonies and doctrines of the Roman Catholic Church, making changes only where there seemed a direct opposition to the teachings of the Bible, while Zwingli desired to sweep away all additions and have nothing in form, ceremony or doctrine that was not directly sanctioned by the Scriptures. A conference was arranged between the two men at Marburg in 1529 that they might come to an understanding on the questions at issue between them, but on the Lord's Supper they could come to no agreement, Luther holding to the literal meaning of the words, "This is my body." The Swiss Reformation became involved in politics, and war broke out between the Catholic and Protestant sections, in which war Zwingli was killed and the Reformation in German Switzerland became of relatively little importance compared with the work which began in French Switzerland at Geneva. The way had been prepared by Farel, a bold and successful French Protestant preacher, who had been driven from his own country by persecution. He invited John Calvin, a refugee like himself, to assist him in the work at Geneva. He accepted and began his work in 1536, and with the exception of brief intervals spent his life there, making Geneva the theological centre of Protestant Christendom. He is the theologian of the Reformation and also a great organizer. His 'Institutes of the Christian Religion,' written when he was 27 years old and subsequently enlarged, though not essentially changed, clearly sets forth the doctrines of the Reformed Church and has great influence even to the present day. He organized the church at Geneva on the Presbyterian model, because he considered this the form of organization enjoined in the New Testament. In other ways he followed Zwingli rather than Luther, though taking a position between the two in regard to the Lord's Supper. His great influence in the Reformation movement is due to his influence on the many students and refugees who came to Geneva for instruction or safety and then carried his theological system and form of government back to France, Netherlands, England, Scotland and other parts of Europe.

When Luther began his work in Germany Francis I. was king of France and the rival of Charles V. and naturally inclined to favor a movement which might injure the German Emperor. He and his court were favorers of the Renaissance and did not object to a reform of the Erasmian type. After his death the reformatory movement, now rapidly growing, was vigorously persecuted. It became complicated with political issues, and the Huguenots, as the French Protestants were called, became a polit-

ical party. Catherine de' Medici, the queen-mother, with the aid of the Guises, planned and executed the massacre of the Huguenots on Saint Bartholomew's day, 24 Aug. 1572, in which Coligny, the foremost of the Huguenot leaders, was killed, and numbers of other Huguenots in Paris and the provinces. A religious war followed, which was not terminated till Henry of Navarre, the Protestant leader, gave up his faith and conformed to Roman Catholicism and secured toleration for the Huguenots in the Edict of Nantes 1598.

The Reformation quickly spread from Germany into the Netherlands through nearness, similarity in language and trade relations. Charles V. made severe laws against it, and these laws resulted in the execution of many of the Reformed faith. But he was personally popular in his home country, and there was no political party to oppose him as in Germany. When Philip II. became ruler, he made it evident that he not only would put down heresy, but proposed to rule as an absolute monarch in spite of their ancient privileges. Excessive taxes were imposed and the inquisition became more stringent. The people rallied around their nobles as leaders and revolted. Protestantism grew with great rapidity, especially in the north, but Philip resolved to subdue it, even if it meant the total extermination of the people. The best generals Spain could furnish were sent to put down rebellion and root out heresy, but these efforts were in vain. When the people could not defeat the Spaniards in open combat they cut the dikes and let in the sea. Under the guidance of their often defeated but never discouraged leader, William of Orange, the northern section, Holland, which had become almost wholly Protestant, accomplished their separation from the Spanish crown and the Roman Catholic Church. The southern part, Belgium, remained Catholic. Other countries in northern and southern Europe were affected by the Reformation. In Denmark, Sweden and Norway the Reformation was introduced by pupils of Luther and was generally aided by the authorities for advancing political interests. There was a lack of the enthusiasm which we note in northern Germany and the Netherlands, but the movement grew steadily through proximity to Germany, and these countries became and remained truly Protestant.

The Reformation extended to the south and east of Saxony into Bohemia, Poland and Hungary, carried by enthusiastic students from Wittenberg. Bohemia was prepared for such a movement by the previous labors of Huss, and here it spread rapidly. In Hungary and Poland with the Lutherans and Calvinists there were also Unitarian Protestants. The progress of the Reformation was greatly hindered by the inability of these three to work together, and their quarrels with each other. The Jesuits found this a rich field for their work in the second half of the century. Their work and the Thirty Years' war nearly annihilated the Reformation, so that Bohemia which at one time had not more than one ninth of its population adherents of the Roman Catholic Church is to-day almost wholly Catholic.

The Reformation in England was at first a personal and political revolt against the Pope rather than a religious movement. Henry VIII.

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was a thorough Roman Catholic, but when the Pope refused to grant his request for a divorce he revolted against his authority, but remained essentially a Roman Catholic through his life with this exception that he did not admit the power of the Pope in England, so that this Reformation was largely negative. In the reign of Edward VI., 1547-53, there was a rapid movement toward the position of the continental Reformers, the most important events being the adoption of the Forty-two Articles as the creed of the church and the Book of Common Prayer in the English language to be used in the church service. These were both strongly Calvinistic. When Mary, the daughter of Henry VIII. and Catherine, became queen, her effort was to bring the Church back into the papal fold again and to punish the heretics. The nation through a pliant parliament returned to the Roman Catholic Church and the queen vigorously persecuted the Protestants. The leading Protestants, including Cranmer, archbishop of Canterbury, were burned at the stake, but Protestantism grew under the persecution which was ended by Mary's death in 1558. Her successor, Elizabeth, was a woman of great political shrewdness, but with little religious interest, and her effort was to make religious questions subservient to political problems. Her own preference was for a return to the relationship between church and state which existed in the reign of Henry VIII. Above all else she resolved to be supreme governor of the Church and would not tolerate those who refused to conform to the established worship. She persecuted the Puritans (as those were called who desired a form of worship stripped of the ceremonies and forms which came from the Roman Catholic Church and who refused to conform to her wishes), and also the Catholics. But she was unable to stop the growing spirit of dissent, which expressed itself in the rise of several religious parties. The Independents desired the entire separation of church and state and the independence of the local congregation. The Presbyterians thought that there should be one state church but that it should be organized after the model of the New Testament churches which they considered Presbyterian. Still others would leave the state church as it was, only purified in form and ceremonies. The difficulty was handed down to Elizabeth's successors of the ill-fated Stuart line and reached a partial solution in the toleration act of 1689 in which the Episcopal Church remained the Established Church, but a limited freedom was given to the dissenters.

Closely connected with this was the Reformation in Scotland. Reformers from the Continent, especially from Geneva, preached and died at the stake. The leader of the work was John Knox (1505-72) who holds the position in Scotland which Luther has in Germany. He was a friend and pupil of Calvin and succeeded in establishing a church on the Geneva model in Scotland. Mary Stuart during her short reign tried to re-establish Roman Catholicism in Scotland, but found in Knox a strong and successful opponent. After the death of Knox his work was carried on by Andrew Melville.

Mention should be made of the partially successful efforts of the Roman Catholic Church to stem the tide of Protestantism and win back the

lost territory. The Inquisition was so thoroughly established and did such effective work in Italy and Spain that a promising Protestant movement in both countries was stopped. There was a reformatory work carried on within the Church. In Italy the Oratory of the Divine Love was organized whose object was the moral elevation of the Church. The Council of Trent by its discussions and decisions was a reformatory influence. By it the belief of the Roman Catholic Church was clearly defined and disciplinary reforms brought about. More important than all these was the work of the new semi-monastic order, the Jesuits, who through their missionary work succeeded in gaining many thousand converts to Catholicism.

For fuller details see the following articles: ALVA; AUGSBURG CONFESSION; CALVIN; CALVINISM; COUNCIL OF TRENT; CRANMER; EDICT OF NANTES; ELIZABETH; ERASMUS; HUGUENOTS; HUSS; INDEPENDENTS; INQUISITION; JESUITS; KNOX; LUTHER; MARY STUART; MELANCHTHON; PEACE OF AUGSBURG; PHILIP II.; PRESBYTERIANISM; PROTESTANTS; PURITANS; SAVONAROLA; THIRTY-NINE ARTICLES; WESSEL; WILLIAM OF ORANGE; WYCLIF; ZWINGLI. Also consult Fisher, 'History of the Reformation' (1893); Newman, 'Manual of Church History' (1903); Walker, 'The Reformation' (1900); Jannsen, 'History of the German People' (1900); Denifle, 'Luther' (1904); Stone, 'Reformation and Renaissance' (1904); Gasquet, 'The Eve of the Reformation'; Bishop Spaulding, 'The Protestant Reformation.'

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Reformatories. See PENOLOGY.

Reformatory Schools, schools instituted for the training of juvenile offenders who have been convicted of an offense punishable by imprisonment. The first reformatory managed under legislative control was the one established in New York in 1824, known as the New York House of Refuge. Its success was so marked that at present there are 56 institutions in the United States for the reformation of juvenile offenders. Among them are a number of admirably conducted establishments under the control of religious denominations, to which children are sent, according to the religious creed of their parents, when the same can be ascertained.

Reformed Church. See CALVINISM; DUTCH REFORMED CHURCH; REFORMATION.

Reformed Church in the United States, The, formerly known as the German Reformed Church in the United States of America and an off-shoot of the Reformed Church of Germany. The first minister was the Rev. George Michael Weise, who emigrated with about 400 people of the Palatinate in 1727, and settled in Pennsylvania. In 1746 the Rev. Michael Schlatter was commissioned by the synods of North and South Holland to visit their German missions in America, and regulate their relations. He assembled in Philadelphia the first synod or *coetus* of the German Reformed Church 1747. The German Reformed *coetus* continued under the jurisdiction of the Church of Holland till 1793, when an independent synod was formed. It increased rapidly in membership and congregations. The first triennial general synod, with jurisdiction over the whole Church, met in Pittsburg 1863. The gen-

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eral synod of 1869 resolved to drop the word "German" from the title of the Church. The Heidelberg catechism is the only standard of doctrine. The worship of the Church is liturgical; its government is presbyterian. Reception into the full communion of the Church takes place by the rite of confirmation. Christmas, Good Friday, Easter, and Whitsunday are observed with much solemnity. Eleven English and five German papers are published in the interest of the Church; and there are 16 theological and literary institutions under its control. Statistics, 1910: Churches, 1,737; ministers, 1,230; members, 293,836.

Reformed Episcopal Church, a denomination organized by members of the Protestant Episcopal Church, who give substantially the following statement of the events and circumstances which, as they believe, justify their course: (1) The Protestant Reformation in England had outwardly a political origin (in the act of the king, Henry VIII., renouncing allegiance to the pope, and proclaiming himself head of the English Church); by which the work was biased and cut short. During the brief life of the young king, Edward VI., the regent, or protector, being in favor of the Reformation, great progress in it was made. Under Mary the supremacy of the pope was again acknowledged. When Elizabeth became queen, wishing to harmonize her divided subjects, and hoping for reconciliation with Rome, she strove to have the liturgy framed so as to satisfy both parties. Consequently it contained contradictory elements. At a later period, when she had found her hope futile, the articles of faith adopted were decidedly Protestant. Thus it came to pass that in the Church of England two parties found support in her ritual; the one Protestant, the other having an affinity with Rome. (2) After the American Revolution, when the Church of England in the colonies became the Protestant Episcopal Church of the United States, the Book of Common Prayer, having been adopted without material alterations, retained its conflicting elements. (3) The Tractarian movement, which began at Oxford, 1833, was a successful endeavor to revive the principles of antiquity and Catholicity contained in the Prayer Book, in opposition to its Protestant elements. It discarded Protestant principles and taught the doctrines of apostolic succession, priestly absolution, baptismal regeneration, the real presence, and the authority of the Church. (4) These teachings produced a powerful effect in the United States also. A great increase in ritualism, and of the drift toward Rome, was soon manifested; the opposition between the "High" and the "Low Church" parties was intensified, and practical measures were adopted by each which widened the chasm. (5) Several subsequent public events fanned the flame of discontent, especially the censure of one clergyman for preaching in a Methodist church, and the suspension of another for omitting the word "regenerate" in the baptismal office. (6) Remonstrances and petitions for relief, which were numerous and urgently presented to the General Convention, produced no effect. (7) During the sessions of the Evangelical Alliance in New York in October 1873, Bishop Cummins of the diocese of Kentucky, having, by invitation, officiated at a union celebration of the Lord's Supper, in com-

pany with representatives of other denominations, was for this act of Christian fellowship bitterly censured through the press by members of the High Church party. After this, convinced that he could no longer rightfully continue in a Church whose theory and practice (as interpreted by the majority of its members) denied the brotherhood of believers in Christ, Bishop Cummins withdrew from the ministry of the Protestant Episcopal Church. (8) This led to the organization in 1873 of the Reformed Episcopal Church, of which Bishop Cummins and the Rev. Dr. Charles E. Cheney were elected bishops. At the same time the following declaration of principles was adopted: I. The Reformed Episcopal Church "holding the faith once delivered to the saints" declares its belief in the Holy Scriptures of the Old and New Testaments as the Word of God, and the sole rule of faith and practice; in the creed "commonly called the Apostles' Creed"; in the divine institution of the sacraments of baptism and the Lord's Supper; and in the doctrines of grace substantially as they are set forth in the Thirty-nine Articles of Religion. II. This Church, recognizes and adheres to Episcopacy, not as of divine right, but as a very ancient and desirable form of Church polity. III. This Church, retaining a liturgy which shall not be imperative or repressive of freedom in prayer, accepts the Book of Common Prayer, as it was revised, proposed, and recommended for use by the General Convention of the Protestant Church, 1785; reserving full liberty to alter, abridge, enlarge, and amend the same as may seem most conducive to the edification of the people, "provided that the substance of the faith be kept entire." IV. This Church condemns and rejects the following erroneous and strange doctrines as contrary to God's word: (1) That the Church of Christ exists only in one order or form of ecclesiastical polity. (2) That Christian ministers are "priests" in another sense than that in which all believers are "a royal priesthood." (3) That the Lord's table is an altar on which the oblation of the body and blood of Christ is offered anew to the Father. (4) That the presence of Christ in the Lord's Supper is a presence in the elements of bread and wine. (5) That regeneration is inseparably connected with baptism. To this statement it may be added that in this Church the bishops do not constitute a separate order, but are presbyters; in council they vote with and as their brother presbyters, and are subject to confirmation or appointment by the general council. Statistics, 1910: Churches, 80; ministers, 94; members, 9,610.

Reformed Judaism in America. See JUDAISM, REFORMED, IN AMERICA.

Reformed Presbyterian Church. See CAMERONIANS.

Reformed School of Medicine. See MEDICINE, ECLECTIC.

Refraction, a deviation in the course of a ray of light when it passes through the surface of a transparent medium. A familiar result of refraction is seen when one looks very obliquely into a transparent pool of water, of which the bottom is visible. The water seems much shallower in such a case than it really is. Another example is the bent appearance of the oars of a boat when the blades are seen obliquely

REFRACTION

under water. When ordinary light is refracted, it is also decomposed into light of the various elementary colors. This decomposition is due to the unequal refraction of light of different wave-lengths; and the resulting separation is known as *dispersion*. It is too small to be noticed in ordinary cases, such as those we have already cited. But, on looking at a source of light through a glass prism, it is very evident. See LIGHT; SPECTRUM.

The general theory of refraction is quite simple, and may be expressed in the following way: The power of a transparent medium to refract a ray of light is expressed by a certain

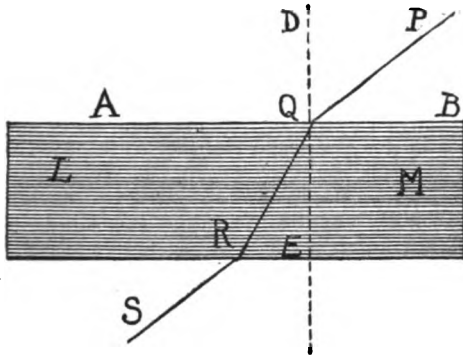


FIG. 1.

number called its *index of refraction*. The phenomenon of dispersion shows that this number is different for rays of different colors, or wave-lengths. It is generally greater the denser the medium; but to this rule there are many exceptions. The mathematical principle by which the amount of refraction is determined is as follows: Let AB represent the surface of a transparent medium, LM. Let a ray of light, PQ, strike this surface obliquely at Q and enter the medium, and let QR be its course through the medium. Draw through Q the perpendicular DE. Then the angle PQD which the ray makes with the perpendicular before it enters the medium is called the *angle of incidence*; and the angle EQR which it makes after entering the medium is called the *angle of refraction*. The law of refraction then is:

For one and the same medium, and the same ray of light, the ratio of the sine of the angle of incidence to that of the angle of refraction is a constant quantity for the same medium and the same ray.

This constant ratio is called the *index of refraction*. The law may be expressed in algebraic language as follows: Put

- I, the angle of incidence;
- R, the angle of refraction;
- n , the index of refraction.

Then we shall have

$$n = \frac{\sin I}{\sin R}$$

or,

$$\sin R = \frac{\sin I}{n}$$

It is a law of the course of light that, if a ray passes in the opposite direction, say from R to Q, it will continue on the line QP after leaving the medium. It follows if the ray

PQ emerges from the medium at R it will suffer refraction according to the same law as a ray entering it, but in the reverse direction. Hence if the lower surface of the medium is parallel to the upper surface, the emerging ray RS will be parallel to PQ.

One result of the above law is that a ray entering or leaving a medium in a direction perpendicular to the surface of the latter will undergo no refraction, but will continue in the same straight line. In this case the angles of incidence and refraction are both zero.

From the above equation we find that, if the angle R and the index of refraction are given, we can find the angle of emergence by the equation

$$\sin I = n \sin R.$$

Now, the angle R may be so large that this expression is greater than 1. Then there will be no possible value of the angle of emergence to fulfil the condition. It is found that, in this case, the ray will not emerge from the medium at all, but will be reflected from its inner surface as if the latter were polished and opaque. This is called *total reflection*, and is frequently applied in optical instruments. An example will show how this result may be brought about. Let ABC, Fig. 2, be the section of a glass prism, the angle at C being a right angle. Let a ray enter the prism at the point Q in a direction perpendicular to the surface BC. It will then pass on and will reach the lower surface of the prism at the point R. The angle DRQ will then be 45 degrees. The sine of this angle is 0.707 +.

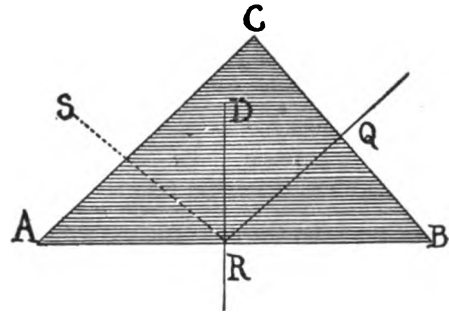


FIG. 2.

Now, a glance at the table which follows will show that in all sorts of glass the index of refraction is greater than 1.5. It follows that the sine of the angle at which the ray QR should emerge from the prism would be greater than 1.5×0.7 , and therefore greater than 1. There is then no possible angle to fulfil the conditions. The light is therefore reflected in the direction RS, as though the surface AB were perfectly opaque and highly polished.

Indices of Refraction of Various Substances.

— Any one definite chemical compound has, at a given temperature, always the same index of refraction for the same ray. But glass is not such a compound, because its ingredients differ in different specimens of glass. It is impossible to make two pots of glass so exactly alike that they shall have the same index of refraction. It is owing to this fact that the idea frequently entertained, of making a telescope by putting together different pieces of glass, is impracticable.

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cable. The following table shows the indices for a number of common transparent substances, and for three of the principal rays, C, D, F. It will be seen that glass has a greater refracting power than water; and that plate glass is more refracting than crown. The diamond is the substance which has the greatest refracting power of all. It has also a great dispersive power; and it is owing to this fact that a diamond with polished faces shows so many brilliant colors when a ray of light falls upon it.

TABLE OF INDICES OF REFRACTION.

	Ray C	Ray D (mean)	Ray F
Soft crown glass....	1.511910	1.514580	1.520994
Medium crown glass....	1.513558	1.516149	1.522343
Hard crown glass....	1.514571	1.517116	1.520994
Light flint glass....	1.537682	1.541022	1.549125
Medium flint glass....	1.575903	1.579880	1.589870
Dense flint glass....	1.645773	1.651242	1.664981
Rock salt	1.54050	1.54418	1.55324
Iceland spar	1.65435	1.65833	1.66780
Rock crystal	1.54190	1.54424	1.54970
Fluor-spar .....	.....	1.4339	.....
Canada balsam	1.528	.....	.....
Diamond .....	.....	2.470	.....
Ice	1.306	.....	.....
Quartz .....	.....	1.5442	.....
Water	1.3307	1.3324	1.3366
Carbon sulphide....	1.6240	1.6333	1.6584
Air	1.000290	1.000292	1.000294

The refractive power of a substance is different at different temperatures. As a general rule, glass refracts more the colder it is. Consequently the focal length of a telescope will generally be slightly shorter the colder the weather. The difference is, however, slight and there are exceptions to the rule.

Refraction by the Atmosphere.—It will be seen by the preceding table that air has an appreciable, though slight, refracting power. It follows that a ray of light coming from a star is gradually bent toward the perpendicular as it approaches the surface of the earth. Only when a star is in the zenith does the ray suffer no refraction. The result is that astronomical observations upon the declination or altitude of a heavenly body require to be corrected for refraction. The latter, depending upon the density of the air, is greater the colder the air and the higher the barometer. Hence the astronomer has always to record the readings of his thermometer and barometer when he observes the altitude of a heavenly body. A rough approximation to the amount of the refraction can be made by the rule that, at small zenith distances it is nearly 1" for each degree of zenith distance; and that, if the altitude is not greater than 45°, it increases nearly as the tangent of the zenith distance. The rate of increase is somewhat less than that given by this law, but still the refraction increases rapidly as we approach the horizon, where it usually amounts to about 35'. This is greater than the diameter of the sun or moon. It follows that, when we see the lower limb of the sun just touching the horizon at sea, the luminary is actually entirely below the horizon. Moreover, the lower limb is elevated more by refraction than the upper one, with the result that a certain ellipticity is produced in the apparent outline of the sun, which is plainly perceptible to the naked eye.

A ray of light always suffers refraction when passing through the air in any other than a ver-

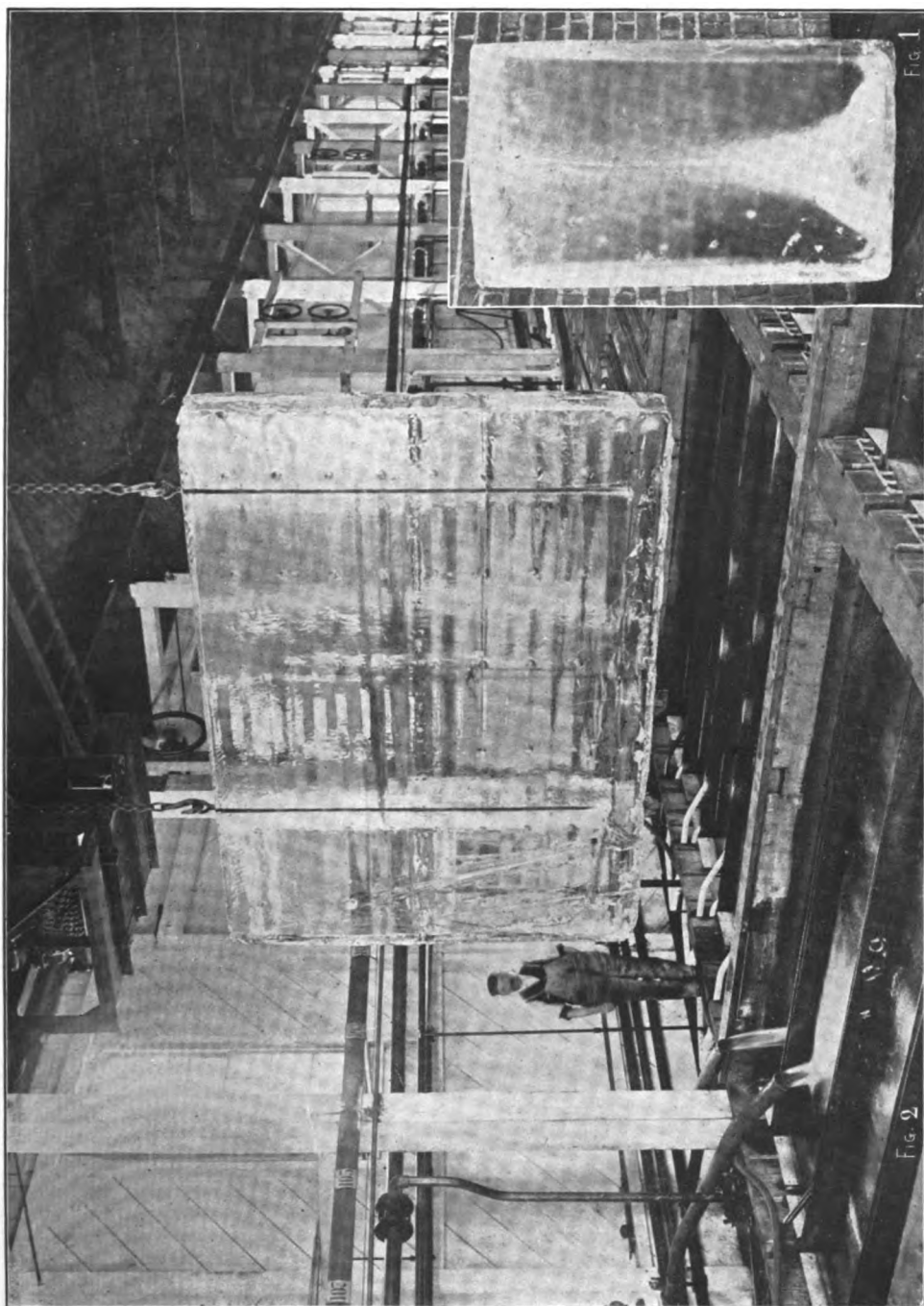
tical direction, and its course is most curved when it is horizontal. In this case the curvature under ordinary conditions of the air is about 1/6 that of the earth. But this result depends entirely at the rate of increase or diminution of the temperature as we rise above the ground. If the air is very cold near the ground, and rises rapidly in temperature above it, a horizontal ray may be more curved than the earth, and strike the latter at some point. Objects may then be seen at such a distance that they are far below the horizon, as was once noticed by an Arctic navigator who, when separated from one of his ships, saw her image upside down above the horizon and, sailing toward it, found the ship. In the contrary case, when the air near the ground is much warmer than at a small height above it, the reverse effect is produced. A horizontal ray is then refracted upward so as not to strike the earth at all. It is through this action that the mirages, so frequent in the desert and elsewhere, are produced. See MIRAGE.

S. NEWCOMB.

Refrigeration and Refrigerating Machinery. Refrigeration is the operation of cooling substances by artificial means. Natural ice forms the greatest source of refrigeration, but there are certain conditions where cold produced through mechanical means possesses advantages over natural ice, which have led to the development of a number of refrigerating machines. The advantages of mechanical refrigeration over that produced by natural ice are that the temperatures of the objects cooled can be more readily regulated, lower temperatures can be obtained, and in many cases the desired cooling effect can be secured at a lower cost. Refrigerating machines are used in cold storage warehouses, and allow the temperatures of the rooms to be readily adjusted so that their contents are either frozen or held at temperatures slightly above the freezing point. They are extensively used in various manufactures such as brewing. There are also numerous plants for the production of artificial ice, which possesses hygienic advantages over natural ice when used in such a way as to bring it in direct contact with food or drink, in that it may be made free from bacteria; whereas the natural ice holds those originally in the water without destroying them. Many bacteria can even withstand the extreme cold produced by liquid air of about 300° F. below zero without losing their vitality.

Ice as a Refrigerant.—With the present mode of life ice is a domestic and commercial necessity. And yet the extended use of ice in many fields is of comparatively recent origin. Nero had ice houses constructed in Rome, and ice houses for storing natural ice have been in use for centuries, yet it is but a short time since refrigerating cars have made it possible to ship Western beef to New York and the fruits of California to any part of the United States.

Ice-making.—The production of artificial ice. The heat is usually abstracted from the water to be frozen by evaporating a volatile liquid, such as ammonia, sulphur dioxide, or ether, which in evaporation absorbs heat. Anhydrous ammonia is most commonly employed. This boils at 27° F. below zero at atmospheric pressure. If the anhydrous liquid ammonia is



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introduced in a coil of pipe which is placed in a tank of brine it will absorb heat from the brine during the process of boiling equal to the latent heat of evaporation. If a can of water is immersed in the brine it will in turn be cooled and then frozen, and this process constitutes the elements of the Can System of ice-making. If on the other hand, the ammonia in the coil is made to cool a flat plate forming the vertical side of a water reservoir ice will be formed directly on the plate, and this constitutes the elements of the Plate System of ice-making. The vapor produced when the liquid ammonia evaporates in the coil, is, in all cases, again converted to the liquid state so that it may be used over again. In abstracting heat from the refrigerating coil the vapor is at a low pressure, say 15 pounds per square inch above the atmosphere at which the boiling point of the liquid is 0° F. To convert it to a liquid it must be raised in pressure, to say 140 pounds per square inch above the atmosphere, at which the boiling point of the liquid is 80° F. As the temperature at the boiling point of a vapor is the same as that at the condensing point, the vapor at 140 pounds pressure can be condensed by cooling it to 80° F., and after such condensation it may be returned to the refrigerating coils and used over again for abstracting heat from the brine. To raise the pressure of the gas from 15 pounds to 140 pounds per square inch we may employ either of two methods—compress it by means of an engine, or we may absorb the vapor in cold water and then heat the aqueous solution of ammonia in a still, and so drive the gas off at high pressure. These two methods of compression constitute the distinguishing features of what is called the compression and absorption systems of ammonia refrigerating machines.

In the can system of ice-making, distilled water which has been freed of air is ordinarily used for freezing and this produces a cake of transparent and clear ice with the exception of a thin feather of air bubbles in the centre of the cake and a portion of the top of the cake which is white where the water expands over that first frozen. A cake of ice made by the can system is shown in Fig. 1. The distilled water from which ice is made is obtained by condensing the exhaust steam from the engine of the refrigerating machine and by condensing live steam. In an economical plant the steam required to run the engine and for other purposes is less than the amount of ice produced, and to make up the difference some live steam is admitted directly to the condenser in order to supply the necessary amount of distilled water. In an ice-making plant where the water is distilled by evaporating it in an ordinary boiler, the weight of ice made per pound of coal is, therefore, limited by the evaporation of the boiler and the amount of ice produced is less than the total amount of steam generated by what is lost through the drips from the steam pipes and other causes. It is possible, therefore, to make more ice per pound of coal by the plate system of ice-making where the water is not distilled than it is by a can system as ordinarily operated. In an economical compression plant where the ice is made by the can system a single cylinder engine working without a vacuum will require less steam to run it than the weight of ice which

is produced, and if distilled water is used for freezing it will not increase the efficiency to employ a more economical engine. In a plate system, however, a compound engine may be used with a corresponding gain in the efficiency.

In order to make it possible in a can system to make a greater amount of distilled water ice than the weight of water evaporated by the boiler it has been proposed to use multiple-effect evaporators for distilling the water. This was done in a plant at Newark, N. J., but the system had to be abandoned on account of the evaporator becoming coated with a hard scale which was deposited from the water to such an extent that the evaporator soon fell off in its capacity and efficiency. Where the steam from the engine operating the refrigerating machine is condensed in order to obtain distilled water for making the ice, the oil which this water contains must be eliminated. This is accomplished by re-boiling the water which comes from the condenser in an open tank by means of a jet of live steam; then cooling and running it through an oil separator and finally through charcoal filters. Re-boiling the distilled water removes the air which it may contain. It is possible to so thoroughly remove the oil that there will be no traces of it in the ice, whereas, if this is done imperfectly, the centre of the cake, when freshly broken open, will have a slight smell resembling that of tar. The presence of a trace of oil can be detected by the odor when it cannot be detected by taste. In the plate system the ice is formed on the flat cooling surface to the depth of about 6 inches in 2 days, 9 inches in 4 days, and 12 inches in 7 days. The plates on which the ice is frozen are about 10 by 14 feet in area. A cake of ice which has just been drawn or harvested from the tank of a plate system is shown in Fig. 2. The plates are usually allowed to build up to about 12 inches thick before harvesting. They are then melted free from the cooling plate by passing hot ammonia gas under pressure into the cooling coil which by condensation supplies the necessary heat. After this the blocks of ice are cut to the size required by sawing or by a parting tool heated by steam. In some plate systems cold brine instead of ammonia is circulated through the cooling coils. In the plate system the water in contact with the freezing plates is agitated by means of compressed air which is admitted from a perforated pipe placed near the bottom of the tank. As the ice freezes from one side only it forces the impurities and the air contained in the water to its surface, and the circulation produced by the air bubbles floating upward through the water assists in removing the impurities and air bubbles from the surface. A clear transparent ice is thus produced.

The results of tests of a can and a plate system of ice-making are given in Table I., which follows. The test of the can system was made by Messrs. Hupfel, Griswold and Mackenzie of the class of 1893 of the Stevens Institute of Technology as a graduation thesis. The plant was that of the Hygeia Ice Company, New York. The tests of the plate system were made by Messrs. Warner, Moore, Hunt, and Quick of the class of 1904 of the Cornell University as a graduation thesis, the tests being made on the plant of the Diamond Ice Company at Wilmington, Del.

REFRIGERATION AND REFRIGERATING MACHINERY

TABLE I.—RESULTS OF TESTS OF TWO ICE-MAKING PLANTS, ONE USING THE CAN SYSTEM AND THE OTHER THE PLATE SYSTEM.

	Can system	Plate system
Fuel used*.....	Buckwheat and pea	Bituminous coal
Type of engines driving compressors	Simple	Compound
Total ice made per pound of coal as fired	7.28	11.02
Percentage of ice lost in removing from cans or in harvesting and cutting	2.2	12.0†
Net ice made per pound of coal as fired in pounds.....	7.12	9.70
Total ice in pounds per hour per horse-power of steam cylinder.	38.6	37.9
Net ice manufactured per day in tons of 2,000 lbs., compressors of can system running 12 hours per day, and of plate system 24 hours per day.....	97	109
Average pressure of ammonia gas at condenser in pounds per square inch above the atmosphere	135.2	118.6
Average back pressure of ammonia gas in pounds per square inch above the atmosphere	15.8	9.1
Pounds of water evaporated at boilers per pound of coal.....	8.085	8.02
Total horse-power developed by compressor engines	444	274

APPROXIMATE DIVISION OF STEAM IN PER CENTS OF TOTAL AMOUNT.

Compressor engines	60.1	69.6
Live steam admitted directly to condensers	19.7	0
Steam for pumps and auxiliaries.	7.6	25.1
Live steam for re-boiling distilled water	6.5	0
Steam for blowers furnishing draft at boilers ‡.....	5.6	0
Steam for dynamo engines ‡....	0	2.9
Steam for removing ice from cans and for harvesting and cutting the ice.....	0.5	2.4

*The calorific value of the coal used in the two tests was about the same.

†This loss is excessive and with a proper system of cutting could readily be reduced to about one half, which would make the net produced per pound of coal 10.4 pounds instead of 9.7 pounds.

‡The blowers and dynamo engine are not necessary adjuncts to the ice-making plants, and the steam used by them should be eliminated from the comparison. One of the items tends to counterbalance the other, however, so that the comparative figures for the performance of the two plants are fair ones.

In the so-called vacuum ice-making machines water is used as a working fluid, and it is cooled to the freezing point by its own evaporation. In these machines the water is injected into a refrigerating chamber in which a vacuum is maintained and a portion of the water is frozen by the cooling effect produced by the evaporation. In some machines the vacuum is maintained entirely by mechanical means and in others by the combination of an air pump and a reservoir of strong sulphuric acid for absorbing the water vapor. Where acid is used it is heated after it has become weak through the absorption of water vapor and after concentration is returned to the machine and used over again as an absorbent. Where a vacuum is maintained entirely by mechanical means a very large cylinder displacement is required in the

air-pump. One machine constructed on this principle had a cylinder 20 feet in diameter and a stroke of 10 feet, and made 20 double strokes or revolutions per minute. The ice produced is white, opaque and hard. It is produced in large cakes and cut by a saw to the size required for commercial use.

Ammonia Compression System with Brine Circulation.—Fig. 3 shows a compression system for a cold storage warehouse. A is the compressing cylinder which is driven by the steam engine B. The gas on being compressed in A passes up through the pipe *aa* to the condenser C, where it is liquefied. The liquid anhydrous ammonia passes from the condenser through the pipe *bb* to the liquid ammonia reservoir D. From the reservoir D the liquid ammonia passes through the valve E, termed "the expansion cock," where it is reduced in pressure from say 140 pounds per square inch above the atmosphere to a pressure of say 15 pounds per square inch above the atmosphere, and thereby is reduced in temperature from about 80° F. to about 0° F. The anhydrous ammonia at a temperature of about 0° F. flows in coils of pipe in the brine cooling tank F, and abstracts heat from the brine by being evaporated. The gas produced by the evaporation of the ammonia passes from the condenser coils through the pipe *cc* to the compressing cylinder A, where it is again compressed and returned to the condenser. The brine which is reduced in temperature in the cooler F is pumped by means of the pump G through the pipes *dd*, which are connected with coils HH in the cooling rooms II. After the brine has passed through the cooling coils it is returned to the cooler F. In passing through the expansion cock E about 10 per cent of the weight of the anhydrous ammonia will be vaporized and it is the heat required to produce this vaporization that causes the liquid to be reduced in temperature from say 80° F. before throttling to 0° F. after throttling. Ninety per cent of the ammonia is, therefore, in the liquid state when it has attained the temperature of ebullition corresponding to the pressure existing in the cooler. The brine in the cooler is at a slightly higher temperature than the liquid ammonia contained in the coils and transmits heat to it so as to boil it and convert it into gas. The brine in parting with its heat is thus cooled to the extent of the heat required to evaporate 90 per cent of the liquid ammonia which passes through the throttling cock. In some types of compression machines all of the ammonia is not allowed to vaporize in the cooler, whereas in other systems care is taken to secure a complete evaporation. This gives rise to two classes of machines, one of which is known as the wet or cold compression and the other as the dry compression system. The brine returns to the cooling tank after passing through the storage rooms at about 6° higher temperature than that at which it leaves the cooler and the mean temperature of the brine is about 10° higher than the boiling point of the ammonia corresponding to the suction-pressure. The mean temperature of the brine is 6° less than that of the air in the storage rooms. For the storage of beer a temperature of about 36° F. is required, and this is secured with a pressure of about 28 pounds per square inch above the

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atmosphere in the coils of the cooler. Slaughter houses require about 25° F. in their storage rooms, which must be obtained by a pressure of about 22 pounds per square inch in the cooler. The storage of fish requires a temperature of about 0° F., for which a pressure in the brine coils of the cooler of about 5 pounds per square inch above the atmosphere must be used. Instead of a brine made with ordinary salt one formed from chloride of calcium is often used as a circulating medium because it produces less corrosion in the pipes than salt brine and may be brought to a lower temperature before it freezes or becomes partly congealed. In another system air is blown around the coils of the cooler and is circulated through the storage rooms, and a chamber freshly filled with material can be more quickly cooled than by the use of cooling coils. The air system appears to be more expensive to operate than the brine system.

Direct Expansion Systems.—In some machines instead of expanding the ammonia in coils placed in the cooler and forcing cold brine through the coils in the refrigerating rooms the anhydrous ammonia is expanded directly in coils placed in the refrigerating rooms. In this system we eliminate the loss due to the difference in temperature between the brine and the coils in the cooler. The use of brine is, however, regarded by many as a safeguard against dam-

cylinder is about 100° F. higher than this, and if the cylinders were non-conductors of heat the wet process would be more economical than the dry. It appears by tests, however, that the influence of the conductivity of the cylinder walls in abstracting heat in one part of the cycle and giving it back in part in another, makes the two systems about equal in economy.

Ammonia Absorption System.—As has already been explained, the essential difference in an absorption machine and a compression machine consists in the method of increasing the pressure of the ammonia gas leaving the refrigerating coils. For the compressing pump and the steam-engine in the compression system there is substituted a vessel called an absorber, and a pump for pumping the liquid into a steam still. The condenser, liquid ammonia reservoir, expansion cock and cooler are the same in the two systems. A section of an absorption refrigerating machine is shown in Fig. 4. A is the still or generator in which the aqueous ammonia is heated in order to drive off the gas. The ammonia gas passes off through the pipe *aa* to the rectifier B, where the gas is cooled to a point where any water vapor in it will be condensed. The ammonia gas free from water vapor passes to the condenser C, where it is condensed and passes through the pipe *bb* to the ammonia reservoir D. From the reservoir D the liquid ammonia passes through the valve,

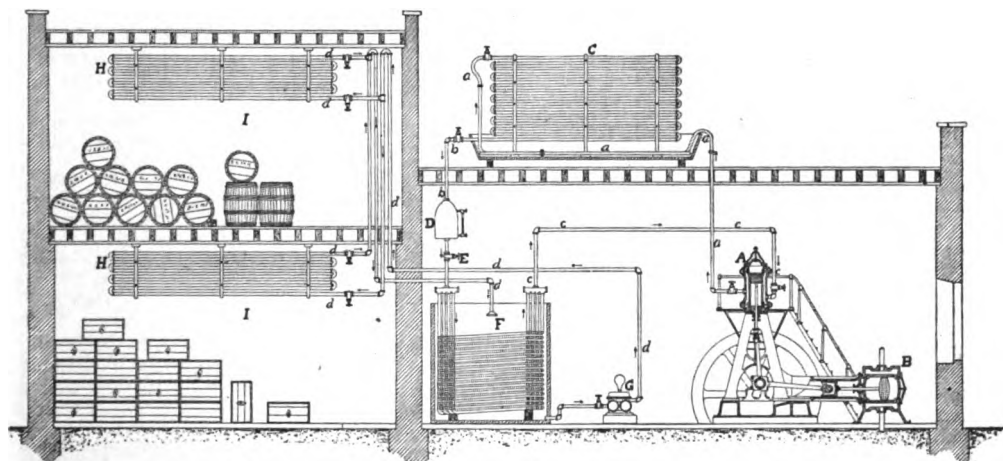


FIG. 3.

age to the material in the store room by the accidental escape of ammonia from the circulating pipes; the brine circulation is for this reason much used, notwithstanding the fact that the cost of the piping is less for the direct expansion system and that there is a saving in the cost of operation. This saving is due to dispensing with the brine circulating pump and permitting from 5 to 10 pounds higher pressure to be used in the coils of the cooler. In the wet system of compression, known also as the Linde system, the presence of liquid ammonia in the compression cylinder limits the highest temperature attained by the ammonia during compression to the boiling point of the ammonia liquid corresponding to the highest pressure, or say to 80° F. With the dry system of compression the maximum temperature in the compression

or expansion-cock E, into a refrigerating chamber or cooler F, where it is evaporated through heat supplied by the coils contained therein through which a calcium chloride brine is circulated. The cold brine is circulated through the pipes *dd* to and from coils in the cold storage rooms. The ammonia gas leaves the cooler through the pipe *cc* and enters near the top of the absorber J, where it meets a spray of weak ammonia liquor, which is conducted to it through the pipe *ee*. The ammonia gas is taken up by the weak ammonia liquor in the absorber and forms the strong liquor which leaves the absorber through the pipe *ff* and is forced by the pump K through the pipe *ll*, the exchanger L and the pipe *mm* into the top of the generator, thus completing the cycle. Heat is given off by the ammonia on absorption, which is taken

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up by water circulated through coils contained in the absorber. The exchanger L saves heat which would otherwise be lost, and thus increases the efficiency of the machine. The weak liquor on leaving the generator is at the highest temperature at which the aqueous ammonia is brought in the system, whereas the strong liquor leaving the absorber is at the lowest temperature. It is necessary to cool the weak liquor before it enters the absorber and to heat the strong liquor to the temperature of the generator, and this is accomplished, in part, by the exchanger by making the weak liquor heat the strong liquor and the strong liquor cool the weak liquor. The weak liquor at about 270° F. is taken off near the bottom of the generator and passes through the pipe *nn* to the top of the exchanger L and thence through a coil contained therein. From the bottom of the exchanger it passes through

pipe *rr*. The water vapor condensed in the rectifier together with the ammonia which it carries with it is returned to the analyzer by means of the pipe *ss*. The drip water from the generator coil is discharged through the steam trap N.

Comparison of Ammonia Compression and Absorption Systems.—Tests have shown that the economy of a compression system when driven by an engine requiring 3 pounds of coal per hour per indicated horse-power is about equal to that of the best absorption system when used in connection with a boiler of good efficiency provided the suction pressure of the ammonia gas is about 20 pounds per square inch above the atmosphere—that is when the temperature of the substance to be refrigerated is about 20° F. For higher temperatures and higher suction pressures the compression machine is more economical in fuel, and for lower temperatures

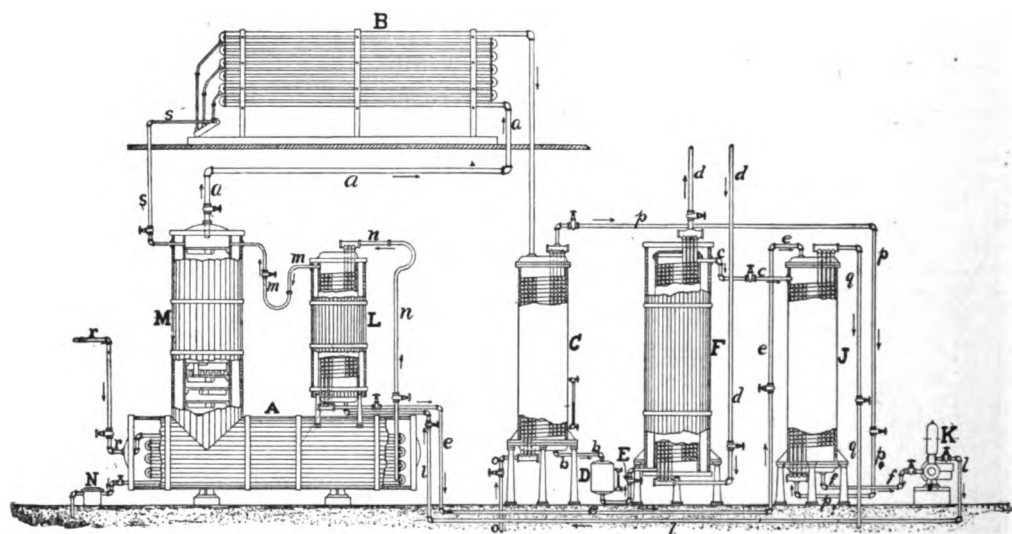


FIG. 4.

the pipe *ee* to the absorber J. The strong liquor at about 130° F. passes through the exchanger L in the reverse direction to that of the weak liquor, and the interchanging of heat is such that the weak liquor leaves the exchanger say 100° F. cooler than it entered and the strong liquor is heated a corresponding amount. The strong liquor is made to enter the top of the generator and pass through what is called an analyzer M. The analyzer adds to the efficiency of the generator by causing the strong liquor to meet the outgoing gas generated at the bottom of the still. An exchange of heat takes place, which causes much of the ammonia contained in the strong liquor to be driven off at a lower temperature than that which exists at the lower part of the still and produces ammonia gas more free from water vapor than could be secured if the strong liquor were introduced into the lower part of the still. The cooling water passes first through the condenser C, entering through the pipe *oo* and from thence to the absorber J through the pipe *pp*. It finally leaves the absorber through the pipe *qq*. Heat is supplied to the generator by means of steam which enters a coil contained therein through the

the absorption machine is more economical, unless the compression system employs a multiple expansion engine so as to reduce the coal consumption below the 3 pounds on which this comparison is based.

Other Compression Systems.—Water, sulphuric ether, sulphur dioxide, carbonic acid, methylic ether, and certain petroleum products may be used in compression systems in the same way as ammonia. In the case of water temperatures colder than 32° F. require a suction pressure of within .08 pound per square inch or 0.16 of mercury of a perfect vacuum. The dimensions of a compressor cylinder of such a plant is about 150 times that for ammonia. The use of water as a working fluid is, therefore, impracticable except for the production of ice as described under *Ice-making*. Sulphuric ether was the first substance practically applied to refrigeration by the compression system. The volume of the compressing cylinder is, however, about 17 times that required for ammonia, and its use has, therefore, been abandoned. Sulphur dioxide machines produce a temperature of about 5° F. in the cooler with a suction of about 3 pounds below, and a condenser-pressure

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about 35 pounds per square inch above the atmosphere. Their economy is about the same as with ammonia, but the compressing cylinder must be about 3 times as large as for ammonia. The Pictet system uses sulphur dioxide, and in some cases what is called the Pictet fluid, which is sulphur dioxide mingled with about three per cent of carbonic acid. Carbonic acid gives a temperature of 5° F. in the cooler with a suction-pressure of about 330 pounds per square inch above the atmosphere and a condenser pressure of about 900 pounds per square inch. The fuel required is more than with ammonia, but the size of the compressor cylinder is about one fourth that required for ammonia. Carbonic acid is used only to a limited extent; but the compactness of the machine employing it, together with the fact that any bursting of a pipe or leakage will not lead to the same disastrous results as with ammonia, renders it more suitable for service on ships and also in some other special lines of work. Nothing definite is known of the economy of the few machines which have used methylic ether and petroleum products. From the physical properties of these substances it would appear that they would give about the same economy as ammonia or sulphur dioxide.

Water Absorption System.—The absorption system may be applied to water or brine as a refrigerating substance and sulphuric acid as an absorbent as mentioned under *Ice-making*. The water or brine is fed into a chamber, where a vacuum within at least 0.16 inch of mercury of a perfect vacuum is maintained by an air-pump. A portion of the liquid evaporates, and temperatures as low as 14° F. may be obtained with brine. The unevaporated liquid is frozen if it is water, or is circulated through the spaces to be refrigerated if it is brine. The water vapor produced through evaporation in the cooling chamber is passed into a vessel containing strong sulphuric acid, which absorbs it, and finally becomes diluted. The diluted acid is pumped into a still or generator, where it is heated and converted to a strong acid, which is used again in the absorber. This method was employed in one of the oldest forms of ice-making machines where a vacuum was produced in a glass bottle or caraffe filled with water and ice was formed inside the bottle for table use. Other substances having a strong affinity for water may be used in place of sulphuric acid. About one fourth of the water is vaporized and the remaining three fourths is converted into ice.

Air as a Refrigerant.—When air at ordinary pressures is used as a refrigerant, the expansion cock marked E in Figs. 3 and 4 must be replaced by a cylinder and piston in which the air in expanding can be made to do work. If air at say 100 pounds pressure above the atmosphere is allowed to enter the cooler through the expansion cock, there would be practically no refrigeration produced. The reason for this is that air at ordinary pressures behaves like a perfect gas. To lower the temperature of the air to any material extent it must be made to do work against a piston. An expanding as well as a compressing cylinder must therefore be provided. The work done by the expanding cylinder may be made to help drive the com-

pressing cylinder. In an air machine having a condenser pressure of 45 pounds per square inch above the atmosphere the volume of the compressing cylinder would be about 20 times that required by an ammonia machine, and the temperature of the air on leaving the expansion cylinder would be about 50° F. below zero. The consumption of fuel for a given refrigerating effect would be about 6 times that of ammonia. If instead of using air at atmospheric pressure a closed system is used, so that the pressure on entering the compression cylinder is about 40 pounds per square inch above the atmosphere, the volume of the compressing cylinder is reduced to about 6 times that required for ammonia, but the economy is about the same as where the air is used at atmospheric pressure. Air machines are used extensively on ships because the use of air does not involve the risk of the cargo through leakage.

Liquid Air.—Air under certain pressures and temperatures is not a perfect gas. If brought to the temperature of 312° F. below zero, air at atmospheric pressure will be condensed to a liquid. Having once obtained the liquid air at atmospheric pressure and its corresponding temperature of 312° F. below zero it may be placed in an open vessel from which it will evaporate only after a considerable time if simply exposed to the atmosphere, because the portion which evaporates must absorb heat energy from the atmosphere equal to the latent heat of evaporation of the liquid air, and as air is a poor conductor the process is necessarily slow. If the vessels containing liquid air are well covered with a non-conducting material, but not sealed, the liquid will evaporate very slowly and may be readily shipped from one point to another. The most efficient way of keeping liquid air is to place it in a Dewar bulb, so called because it was originated by Prof. Dewar, the great experimenter on the liquefaction of gases. This consists of two bulbs of glass, one within the other, joined to a common neck. In the space between the two bulbs there is a very high vacuum which prevents heat being conducted to the inner bulb. The outside of the inner bulb is silvered with mercury in some cases, and this reflects much of the radiant heat, and a bulb of this sort will hold the liquid air longer than one which is not silvered. A silvered bulb holding 5 quarts has been known to hold liquid air for 29 days before it completely evaporated. Ordinarily, liquid air in cans or vessels insulated with non-conductive coverings and holding 10 gallons or upward can be transmitted by train for say two days with a loss of about 25 or 30 per cent. This has led to the proposition to employ liquid air as a commercial refrigerant, but its cost has so far prohibited its use for this purpose. The very low temperature attainable with liquid air makes it seem that some use may be found for it in the arts which will warrant employing it even if it must be supplied at a high cost. It has been proposed to separate the oxygen from the liquid air for commercial use. The method first employed to liquefy air and other gases was to use the liquid from a gas which is readily liquefied to cool a second gas while under pressure and so liquefy the second gas. Then to start with the liquid from the second gas to liquefy a third

REFRIGERATOR—REFUNDERS

and so on. It was shown later that if air were compressed to about 2,500 pounds per square inch and made to pass through a coil to a throttling cock, liquid air could be produced by causing the cold air leaving the throttling cock to pass over the coil so as to cool the incoming air, thus producing a lower and lower temperature at the throttling cock until liquid air appeared and was drawn off from the apparatus. In an apparatus of this sort the weight of liquid air produced was about 5 to 7 per cent of the entire weight of air compressed. In this type of apparatus all the work done by the free expansion of the air is lost, and there is a field open to development by eliminating this loss and at the same time increasing the refrigerating effect.

Performance of Refrigerating Machines.

The performance of a refrigerating machine is measured by what is termed the "ice-melting effect," which is obtained by dividing the amount of refrigeration measured in British thermal units by the latent heat of fusion of ice, which is 142.2. This represents the number of pounds of ice which would have to be melted in order to produce the same refrigerating effect as the machine in question. The number of tons of ice which a given machine produces in 24 hours is also another common unit, but this cannot be made an absolute unit of refrigeration, because the amount of ice produced depends upon the temperature of the water frozen, the losses due to radiation at the freezing tank, etc. The theoretical performance of a compression refrigerating machine is found by computing the piston displacement per minute, and from this determining the weight of gas at the suction pressure which would be drawn into the cylinder and discharged for full displacement. From the law of compression of ammonia gas the horsepower developed in compressing the gas to the pressure existing in condenser is computed, and by adding the friction of the machine the horsepower necessary at the steam cylinder is determined. The cooling effect in British thermal units is computed by subtracting from the total heat of the liquid at the pressure existing in the refrigerating coils the sensible heat of the liquid at the condenser pressure. By reducing this to the equivalent ice-melting effect and dividing by the coal required to develop the horsepower in the engine cylinder we obtain the ice-melting effect per pound of coal.

Table II. gives the results of such computations and compares them with the results actually obtained in tests of refrigerating machines. It may be seen that in all cases the theoretical performance is greater than the actual. The difference is caused by loss due to heating the gas on entering the compressing cylinder, to radiation, and to friction and wire drawing at the inlet and exit valves.

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Refrigerator, a machine or apparatus employed to reduce temperature by chemical or mechanical means. In the restricted sense in which it is most familiarly understood, the term refers to any vessel or chamber in which animal and vegetable substances, solid or liquid, are kept, and are prevented from decaying or fermenting, by the presence of ice, or freezing mixtures, or by the circulation of currents of air or liquid furnished by a refrigerating ma-

chine. Domestic refrigerators of this character are made in a great variety of forms, ranging from the common metal-lined wooden ice-box, provided with a tube to drain off the water from the melting ice in the ice chamber, to the large and elaborate ice-rooms used for extensive storage purposes.

Refrigerator cars employed to transport perishable merchandise without deterioration over long distances may also be considered as belonging to this class. They were first operated



Domestic Refrigerator.

in 1867, between Chicago and New York city, and succeeded in keeping the meat transported fresh and sweet through an interval of 10 days, during the hottest summer months. Each end of a car is provided with a chamber in which blocks of ice are packed on gratings in such a manner as to permit the circulation of a current of air, furnished by a blower driven by a belt on one of the axles, over the ice and through the storage space in the car.

Refuge, Cities of, six Levitical cities divinely appointed as places of refuge to one who had committed manslaughter, and was pursued by the "Revenger" or "Avenger" of Blood. Three (Kedesh Naphtali, Shechem, and Hebron) were west of the Jordan, and three (Bezer in Reuben, Ramoth Gilead in Gad, and Golan in the half-tribe of Manasseh) were east of that river. If the case was proved to be one of murder, the perpetrator might be taken from the City of Refuge and put to death; if it was only manslaughter, the refugee had to remain in the city to which he had fled till released by the death of the high priest (Num. xxxv. 6-34; Josh. xx. 1-9).

Refugees, *ref'ū-jēs'*, a name commonly applied to political or religious exiles, but originally and particularly to the French Protestants who fled from their native country on account of the persecutions to which they were exposed after the repeal in 1685 of the Edict of Nantes, under which the reformed doctrines had enjoyed toleration from the year 1598. About 800,000 Protestants fled from their native country. England, Denmark, Holland, Switzerland, Germany, in the latter especially Saxony, Brandenburg, and Hesse, received these fugitives with hospitality. See HUGUENOTS.

Refunders. See READJUSTERS.

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TABLE II.—ACTUAL AND THEORETICAL PERFORMANCE OF ICE-MAKING MACHINES.
(From Paper by Denton and Jacobus, Transactions of American Society of Mechanical Engineers 1892.)

CLASS OF MACHINE	Authority	Number of test	Dimensions of compression cylinder, in inches		Absolute pressure in pounds per sq. inch.		Temperature corresponding to pressure in degrees F.		Temperature of brine in degrees F.		Revolutions per minute	Horse-power of steam cylinder	Per cent of indicated power of steam cylinder lost in friction	Ice-melting effect in tons per 24 hours		Theoretical no super-heating during aspiration	Actual
			Bore	Stroke	Condenser	Suction	Condenser	Suction	Inlet	Outlet				No friction	With friction		
Ammonia cold compression.....	Schroter	1	9.9	16.5	135.4	55.3	72.3	26.6	42.8	37.2	44.9	17.9	14.4	26.2	58.67	50.23	40.63
	"	2	9.9	16.5	131.4	41.9	70.5	14.3	28.4	21.0	45.1	18.0	16.7	19.5	45.14	37.59	30.01
	"	3	9.9	16.5	128.0	30.3	69.2	0.5	14.0	8.8	45.1	16.8	16.0	13.3	35.04	29.44	22.03
	"	4	9.9	16.5	126.4	22.2	68.5	11.8	0.3	5.5	44.8	15.5	19.5	9.0	28.29	24.74	16.14
	"	5	9.9	16.5	109.5	41.9	95.5	14.4	28.3	23.0	45.0	24.1	10.5	16.5	29.79	26.68	19.07
	"	6	9.9	16.5	135.8	60.0	72.4	30.2	43.7	37.2	45.2	17.9	10.7	29.8	64.74	57.55	46.29
	"	7	9.9	16.5	131.4	45.1	70.6	17.8	28.3	23.0	45.1	18.0	12.1	21.6	48.40	42.50	33.23
	"	8	9.9	16.5	125.6	23.7	68.2	9.4	0.4	5.8	44.7	15.6	18.0	9.9	29.83	24.46	17.55
	"	9	9.9	16.5	116.9	41.0	64.2	13.1	28.4	23.0	45.0	16.4	13.5	20.0	50.53	43.70	33.77
	"	10	9.9	16.5	130.0	60.3	70.0	30.7	42.8	37.3	31.7	12.0	14.8	19.5	69.40	59.09	45.01
Pictet fluid dry compression.....	Schroter	11	11.3	24.4	56.7	20.9	77.3	28.5	43.0	37.5	57.0	21.5	22.9	25.6	55.01	42.28	33.07
	"	12	11.3	24.4	55.6	14.9	76.2	14.4	28.5	23.0	56.8	20.6	22.0	17.9	41.05	31.71	24.11
	"	13	11.3	24.4	54.6	9.7	75.2	2.5	14.1	8.8	57.4	18.5	24.0	11.6	30.23	23.16	17.47
	"	14	11.3	24.4	60.4	6.7	80.6	15.9	0.3	5.7	57.3	15.7	25.7	5.7	32.28	26.36	16.14
	"	15	11.3	24.4	90.9	14.9	104.4	14.4	28.3	23.0	59.3	27.2	10.9	15.7	25.16	20.88	16.05
	"	16	11.3	24.4	61.0	22.3	81.2	31.5	43.5	37.5	57.3	21.6	14.0	28.1	54.32	46.67	36.19
	"	17	11.3	24.4	59.3	15.6	79.6	16.2	28.4	23.0	57.5	20.5	12.8	19.3	40.13	35.01	26.24
	"	18	11.3	24.4	58.7	6.7	79.1	15.9	0.4	5.6	57.8	15.9	21.1	6.8	22.72	17.90	11.93
	"	19	11.3	24.4	54.3	22.2	74.9	31.3	42.8	37.5	35.3	12.4	22.3	17.0	62.83	49.17	38.04
	"	20	11.3	24.4	88.7	15.6	102.9	16.2	28.3	23.1	42.9	19.9	14.7	11.9	26.78	22.86	16.68
Bell Coleman air.....	Schroter	21	11.3	24.4	62.1	6.5	82.2	16.9	0.1	5.3	34.8	9.9	24.3	3.5	21.51	16.30	9.86
Closed cycle air.....	Schroter	22	28.0	23.8	58.8	14.7	64.8*	52.6*	.....	.....	63.2	83.2	21.9	10.3	12.09	7.94	3.42
Ammonia dry compression.....	Renwick Jacobus	23	10.0	18.0	175	53.7	81.3*	40.2*	.....	.....	93.4	38.1	32.1	4.9	14.8	8.1	3.0
"	Denton	24	12.0	30.0	166	42.7	84.2	15.0	36.8	28.9	58.1	85.0	22.7	73.9	35.91	27.36	24.16
"	"	25	12.0	30.0	167	22.9	84.6	10.8	6.3	2.0	57.7	72.6	18.6	37.9	23.18	18.78	14.52
"	"	26	12.0	30.0	162	27.7	82.7	3.2	14.3	2.3	57.9	73.6	19.3	46.5	26.94	21.56	17.55
"	"	27	12.0	30.0	176	42.2	87.7	14.5	36.4	28.5	58.9	88.6	19.7	74.4	33.54	26.94	23.31
Ammonia absorption	Denton	28	.....	.....	152.3	40.4	79.1	12.6	20.7	15.7	.....	.....	.....	42.2	38.5	.....	20.1

* Temperature of air at entrance and exit of expansion cylinder.

REGATTA — REGICIDE

Regat'ta, originally a gondola race held annually with great pomp in Venice on the canals intersecting the city. The term is now popularly employed in the United States and other countries to signify a showy sailing or rowing race, in which a number of yachts or boats contend for prizes.

Regelation, rē-jē-lā'shōn, a phenomenon observed by Faraday in 1850, namely, that two pieces of moist ice placed in contact will freeze together, even in a warm atmosphere. It is proved that beside the pressure from the weight of the upper piece of ice there is atmospheric pressure holding the two pieces together; this pressure melts the ice at the parts which bear on one another, and thus enough heat is absorbed to produce regelation. Professor Thomson's discovery, that the freezing-point is lowered by pressure, explains the motions of glaciers and the apparent plasticity of ice under pressure.

Regenera'tion, the act or the state of being born again in a spiritual sense. The word is a literal version of the term *palingenesia*, peculiar to the New Testament, in which it occurs twice only, namely, Mat. xix. 28, where it signifies the renovation of all things at the second coming of Messiah; and Titus iii. 5, "washing of regeneration," where it signifies a new life, a new spirit in the individual redeemed soul. In many other passages of the New Testament, and specially in John iii. 1-10, the new birth is spoken of without the use of the word regeneration, but in such terms as plainly to indicate that the soul which is received into the kingdom of Christ is born into a new life. Regarding the relation of the sacrament of baptism to the new birth there are chiefly two divergent views entertained by divines. One view, which till the Reformation was well nigh universal, and which is still held by the Catholic Church as an article of faith, regards baptism as the agency whereby the Holy Spirit bestows the new life. According to the other view the washing of water in baptism is but a sensible representation of the spiritual new birth, and regeneration is effected independently of baptism by the direct action of the Holy Spirit. The first view is called that of "baptismal regeneration." Article xxvii. of the Articles of Religion of the Church of England teaches that baptism is "a sign of regeneration whereby, as by an instrument, they that receive baptism are grafted into the Church"; but in 1849, by a judgment of the privy council, it was decided that in the Established Church of England Baptismal Regeneration is not a doctrine taught in her articles and formularies as legally construed.

Regensburg, rā'gēns-boorg. See Ratisbon.

Regent, rē'jēnt, in a general sense, is a ruler, the ruler of a state; in a more limited sense, one who exercises the highest power vicariously during the absence or incapacity of the lawful sovereign.

Regent is also the title of certain state officers of New York who exercise authority over the higher educational institutions.

Regent-bird, a bird of eastern Australia (*Sericulus chrysocephalus*), allied to the bower-birds, which derives its name from the golden color of the head. The males possess a brilliant plumage of glossy satin-like texture and of

black and yellow colors, but the females are dingy in appearance. The regent-birds are of very shy habits, and inhabit the forest depths, making bowers less complicated and striking than those of some other bower-birds (q.v.), but for the same purpose. The food consists of fruits and seeds principally. One of the honey-eaters is called mock regent-bird on account of its black and yellow plumage.

Regent Diamond. See DIAMOND.

Regent's Park, London, England, one of the principal metropolitan pleasure-grounds, covering 470 acres, in the western boroughs of Marylebone and Saint Pancras. The Zoological Gardens are in the northern section of the park, and the Royal Botanic Gardens occupy a circular area in the southern section. See LONDON.

Reggio di Calabria, rēd'jō dē kā-lā'brē-ā, Italy: (1) capital of a province of same name, a seaport town opposite Messina at the extreme southern point of the peninsula. Reggio was founded by Greek colonists at an early period, becoming later a Roman possession. Ancient Græco-Roman baths were recently revealed in excavating. It fell alternately into the hands of Saracens, Spaniards, and Turks, and finally, in 1783, its ruin was almost completed by earthquake. Its chief industries are the manufacture of essential oils, olive oil, silk, and printing. Pop. about 46,000. (2) The province is rugged and mountainous, covering an area of 1,221 square miles.

Reggio nell' Emilia, nēl lā-mēl'lē-ā, Italy, (1) capital of the province of the same name, 38 miles northwest of Bologna, on the canal of Tassone. It is well-built and enterprising. Its chief points of interest are its ancient walls and ramparts, cathedral, and library. Ariosto and Spallanzane (qq.v.) were born in Reggio. Pop. (1901) 59,176. (2) The province lies between Parma on the west and Modena on the east. Its southwest portion is covered by the Apennines. The opposite portion is flat and alluvial, bordering the Po. Area 884 square miles; pop. about 300,000.

Regicide, a term applied to persons who bring about the death of a king, by assassination or otherwise, and specially applied in history to the judges of Charles I., and the members of the French Convention who voted for the death of Louis XVI. Of the judges, 67 in number, who actually sat in trial on Charles I. only 59 signed the death warrant. After the Restoration the regicides were brought to trial on a charge of high treason. Twenty-nine were condemned to death, but only 10 were executed, 19, together with 6 others who were not tried, being imprisoned, most of them for life. More than 20 who were already dead were tried and condemned, notwithstanding, and Cromwell, Ireton, and Bradshaw, three of them, were exhumed and hanged at Tyburn, and then reburied at the foot of the scaffold.

In July 1660, there arrived at Cambridge, Mass., Edward Whalley and his son-in-law, William Goffe, two of the judges who had condemned Charles I. For some months they appeared in public and joined in the devotional meetings in Cambridge and Boston, where they were kindly received. Upon the news of the passage by Parliament of the Indemnity Act.

REGILLUS — REGINA

marking Whalley and Goffe for vengeance as regicides, they fled to New Haven and were received and concealed by Davenport in the "Judges' Cave." They were concealed from pursuit at New Haven and Milford for nearly two years. After this they fled to a cave in New Hampshire, but were there discovered by some Indians and returned to Hadley, Mass., where they were concealed until their death, Whalley dying in 1674, Goffe in 1679. When King Philip attacked Hadley in 1675, Goffe appeared and led the defense. Dixwell, another regicide, also escaped to New England.

Regillus, *ī-jīl'ūs*, **Lake**, a lake of ancient Latium, lying to the southeast of Rome, noted as the scene of a great victory won by the Romans over the Latins 496 B.C. No certain identity has been established with any modern lake, though some would locate it in the crater of an extinct volcano near the town of Frascati, and others find it in the Lago della Doganella, east of the Alban Mount.

Regiment, one of the divisions of a modern army. Regiments appear to have originated with modern standing armies. They are mentioned in France in 1562, and in England in 1588. The regiment may be considered as the unit of organization of a modern army. The various parts which compose it are never permanently separate, except in the artillery, which is organized in an anomalous way. In the United States each regiment of cavalry consists of 12 troops and one band, organized into 3 squadrons of 4 troops each, and under the minimum requirements of the law is constituted as follows:

For each regiment: 1 colonel and 1 lieutenant-colonel, 1 chaplain, and 2 veterinarians. The non-commissioned staff consists of a regimental sergeant-major, 1 quartermaster-sergeant, 1 commissary-sergeant, and 2 color sergeants. For each troop: 1 captain, 1 first and 1 second lieutenant, the enlisted force consisting of 1 first sergeant, 1 quartermaster-sergeant, 6 sergeants, 6 corporals, 2 cooks, 2 blacksmiths and farrier, 1 saddler, 1 wagoner, 2 trumpeters, and 43 privates. A major commands each squadron, for which a staff consisting of an adjutant (1st lieutenant) and quartermaster and commissary (2d lieutenants) and 1 sergeant-major is authorized.

Each regiment of infantry consists of 12 companies and 1 band, organized into 3 battalions of 4 companies each, and under the minimum requirements of the law is constituted as follows: For each regiment 1 colonel and 1 lieutenant-colonel and 1 chaplain. The non-commissioned force consists of a regimental sergeant-major, and 2 color-sergeants. For each company, 1 captain, 1 first and 1 second lieutenant, the enlisted force consisting of 1 first sergeant, 1 quartermaster-sergeant, 4 sergeants, 6 corporals, 2 cooks, 2 musicians, 1 artificer, and 48 privates. See REGULAR ARMY; ARMY OF THE UNITED STATES; etc.

Regina, Canada. The first seat of government in the Northwest Territories and since 1 Sept. 1905 the provisional capital of the new province of Saskatchewan, with no important obstacle in its path to final selection for that honor by the incoming legislature. Regina has

had a degree of progress in recent years quite in harmony with that of the vast country around it.

Railways and Location.—The main line of the Canadian Pacific Railway bisects the city which is also the southern terminus of the Regina & Prince Albert Railway, which serves fertile districts extending 250 miles to the north. It is the western terminus of the Arcola extension of the Canadian Pacific Railway, traversing a rich and fertile country of which 150 miles is tributary to Regina. So with the line from Sault Ste. Marie. The Canadian Northern Railway will soon pass through the city and the Grand Trunk Pacific will tap the district of which it is the centre and will send a branch into the city. Other lines are projected. Regina is the only railway centre between Winnipeg and Calgary, a distance of 840 miles—360 from the former and 480 from the latter.

Industries.—The land in the immediate vicinity of Regina is as good and fertile as that in any part of the continent of America, the soil to the south and north of the railway track being particularly rich. Generally speaking, the characteristic of the land is a black clayey loam three or four feet deep, with a sub-soil of clay. It produces the finest wheat and for vegetables and garden produce the Regina district cannot be surpassed anywhere in the world. The local market gardeners retail their produce to places forty miles away. Wheat grown in the district has been selected by the United States authorities for seed-grain, and many portions of the Dominion send to the district for seed in order to improve the wheat they grow. Not only is the quality of the grain good, but the yield is great. According to the official bulletin of the government the average yield per acre of spring wheat in the Regina district during the last seven years was 20.96 bushels, a figure that is not yet reached by any other locality in the Northwest.

As the provincial headquarters of the Massey-Harris Company, the American-Abell Engine and Thresher Company, the International Harvester Company, the Cockshutt Plow Company, etc., it is the centre of a steadily growing distributing trade. Among the industries of Regina are grain separators and picklers, office and bank fixtures, sash and doors and builders' materials, pressed brick and artificial stone, pork-packing, cement blocks, marble works, soda water, etc., aerated waters, flour mills, foundry and machine works, planing mills and furniture.

Financial and Commercial Progress.—Regina's period of real progress began in 1903. Its assessment in that year was \$1,226,000; in 1904 it was \$2,284,710; in 1905 it was \$3,981,413. On 31 Dec. 1904 its surplus assets over liabilities was \$568,516. The building operations of 1903 are said to have totalled \$500,000 and of 1905 about \$1,000,000. In 1889 the duties paid at the Regina custom house were \$2,500; in 1899 they were \$18,524; in 1903-4 they were \$89,654. The postoffice revenue in 1901 was \$9,607 and in 1904 \$27,260. The value of the money orders purchased rose in the same years from \$18,446 to \$65,581; of money orders paid from \$33,223 to \$96,799; the value of postal notes paid from \$6,445 to \$23,160.

REGIOMONTANUS — REGISTRATION OF PROPERTY TITLES

Institutions and Government. — There are five schools in the city as well as a high school and a normal school, and schools are plentiful throughout the district. There are four weekly newspapers and one daily newspaper, an active board of trade, a live agricultural association, five branches of chartered banks, a club, five hotels; while as to merchandise every branch is supplied by large and well-stocked stores. The professions too are well represented. The elevator capacity is ample, there being 170 elevators with a capacity of 6,000,000 bushels in the district and a flour mill in the city. The Church of England, the Roman Catholic, the Presbyterian, the Methodist, the Baptist and Greek Churches, and the Salvation Army, have each a place of worship; temperance and missionary organizations are active throughout the district, and the city and its vicinity are remarkably free from crime or other indications of a low tone of conduct. The city has also a splendid new hospital with the most modern equipment.

The municipal government of the city is entrusted to an elected council consisting of mayor and aldermen. A vigorous policy of municipal ownership and operation of franchises has been inaugurated. The result is that Regina has an up-to-date electric light service and an excellent gravitation water-works system. An equally good drainage and sewage system is at present in course of completion and the streets and avenues are being boulevarded.

History and Population. — Regina was started as a prairie village, or settlement, and grew for some years rather slowly. In 1882 it was a village of tents; in 1901 its population was only 2,645; in 1905 the population was estimated at 8,000. Yet for years it had been the centre of government for vast regions, including 345,000,000 acres of land. To-day increasing population and production in the surrounding country have made it the commercial, judicial, scholastic and political centre of the province of Saskatchewan.

J. CASTELL HOPKINS,
Editor of 'The Canadian Annual Review.'

Regiomontanus, rē'jī-ō-mōn-tā'nūs, German astronomer, whose real name was Johann Müller, but who assumed that of Regiomontanus, in allusion to the place of his birth, Königsberg (Kings Mountain), Franconia: b. 6 June 1436; d. Rome 6 July 1476. Having received a classical education at Leipzig he placed himself under Purmachi (Georg von Purbach), the professor of mathematics at Vienna, and under him became one of the first astronomers of that age. With Purbachius he accompanied Cardinal Bessarion to Rome in 1461, where Beza gave him further instruction in Greek literature, and he now completed a new abridgment in Latin of the 'Almagest' of Ptolemy (1496), correcting many errors in the former translation, made by George of Trebizond. In 1471 he built an observatory at Nuremberg and established a press; but after three years returned to Rome on the invitation of Sixtus IV., who employed him in the reformation of the calendar, and rewarded his services by raising him to the bishopric of Ratisbon (1475). He died, according to some, of the plague, according to others by poison

administered by the son of George of Trebizond, out of revenge for his having exposed the errors of his father. Regiomontanus was the first in Germany to apply himself to the cultivation of the neglected science of algebra. He made great improvements in trigonometry, into which he introduced the use of tangents. His refutation of a supposed discovery of the quadrature of the circle, and numerous writings on various subjects of natural philosophy, display extensive learning and great acuteness. His astronomical observations from 1475 to 1506 ('Ephemerides') are very accurate. Among his other works 'Kalendarium' (about 1474), 'De Triangulis Omnimodis' (1533); 'Tabulæ Directionum Prejectionumque in Nativitatibus multum utiles' (1585). Consult Gunther, 'Johannes Müller' (in the 'Allgemeine deutsche Biographie,' Vol. XXII., 1855).

Register, the title of a public officer who has charge of records, his duties varying in different States. Also a device for automatically indicating the number of revolutions made or amount of work done by machinery; or recording steam, air, or water pressure, or other data, by means of apparatus deriving motion from the object or objects whose force, distance, velocity, direction, elevation, or numerical amount it is desired to ascertain. There are various appliances of this kind, each particularly adapted for the peculiar operation which is to be investigated; many depending on the action of clock-work mechanism, which indicates results on dials, but others, as in registering meteorological instruments, having means for recording varying conditions, as with the anemometer, barograph, etc. The cash register is a machine for recording money payments. It is of very general use in retail establishments throughout the world.

Registration of Births, Marriages, and Deaths. France has the most perfect system of registering births, marriages, and deaths. There it is the duty wholly of the civil authority, and the methods are so thorough and comprehensive that it is practically impossible for a birth, a marriage or death to occur without going on record. In the United States registration of births, marriages, and deaths is universally required by State laws, but it is only in well organized municipalities that it is fully enforced, and even there much depends on the willingness of doctor, minister, or other civilian upon whom the law imposes the duty of making report to the authorities, to perform that duty. In rural and remote districts births, marriages and deaths often go unrecorded, thus causing doubt and uncertainty which may cast a cloud on property titles and the legitimacy of children. Claims to great age are often made more than doubtful by the lack of any authentic evidence as to date of birth. Indeed, owing to the lax methods of registration which prevailed up to the latter part of the 19th century it is almost impossible to establish the pretensions of alleged centenarians. The importance of registration has of late, however, impressed itself deeply on the public, and everywhere throughout the United States an improvement is being witnessed in this regard.

Registration of Property Titles. The United States leads the world in its system — which is practically the same everywhere

REGISTRATION OF VOTERS—REGNAULT

throughout the Union—of recording property transfers. The possession of a deed of property is not proof of title. The title rests legally in the person in whose name it is recorded in the books of the register or recorder, or by whatsoever name the official having charge of such records is known. The first business therefore of a person acquiring property is to have the deed registered. Otherwise the former owner could sell the same property to another, and if the latter had received no notice of the previous transfer, the transaction, and gave value for the estate, and had his deed recorded first, he could hold the property against the person who had received a previous deed, but had failed to put it on record. The officials in charge of the records are sometimes county and sometimes town officers, and the deed is recorded the moment it is received, even although not entered on the books for some time after. Therefore it is carefully stamped with the hour, minute and even second of its presentation. The old cumbersome English method of vesting title on a trunkful of deeds is therefore unknown in America, where registration has been the rule from the time of the earliest settlers, who allotted lands to each freeman, and made a record of the division.

Chattel mortgages are also recorded; otherwise the mortgagee is without protection against transfer to a third and innocent party who might purchase the goods, or advance money on them.

England has been slow to follow the example of the United States in this as in other matters, but the convenience of the American system and the cumbersomeness of the English, which was growing more top-heavy year by year, has led to the adoption of a method of voluntary registration which makes it possible to transfer and hold property without having to hand over or keep a mass of old title-deeds. In Scotland an excellent system for the registration of transfers of heritable property has existed since 1617.

Registration of Voters. Registration of voters is required by law in most of the American States, as a check to fraudulent voting. In some States a voter having once registered is not required to register again while he retains the same qualifications and residence. In the State of New York yearly registration is required in the large cities, while in the country districts it is not necessary. Previous to registration "repeating"—that is voting more than once in one election—and other frauds were very common, and probably affected the results of important political contests. The voter is required, as a rule, to give his name, age, residence, place of birth, and if of foreign birth, produce his naturalization papers, should the registering officials demand them. For a short time New York State had a law requiring the registry board to make a record of the physical defects of voters for identification, but this proved offensive and unpopular, and was soon repealed. It is a penal offense to make a false statement in registering. See various articles dealing with voting and suffrage.

In Great Britain and on the continent of Europe, voters are required to register, a most exact scrutiny being enforced as to the possession of legal qualifications for the suffrage.

In England the registration of electors was first established by the Reform Act of 1832, in terms of which, in England, the overseers of each parish were required to draw up a register of all persons qualified to vote. This still forms the basis of procedure, but the law has been frequently altered, the latest act on the subject being the Registration Act of 1885.

Regium Donum, *rē'jī-ūm dō'nūm* ("royal gift"), an annual grant of public money formerly received by the Presbyterian and other Non-conformist ministers in England, Scotland, and Ireland. The Irish Regium Donum was withdrawn by the Act of 1869, which came into force in 1871, disendowing the Irish Episcopal Church. Compensation was made of life interests; and the ministers were allowed to commute on the same terms as the clergy of the Church. In 1874 it was reported that the commutation money paid had amounted to \$2,898,810. The Regium Donum in England was enjoyed by the three denominations, Presbyterians, Independents, and Baptists, from 1723 till 1851. The amount required was annually voted by Parliament till 17 July 1857. The Scotch Episcopalians also enjoyed for a time a small share.

Regius (*rē'jī-ūs*) **Professors**, the designation of professors at Oxford and Cambridge whose chairs were founded by Henry VIII. The name is also given to professors in other universities who receive their appointments from the crown.

Regla, *rāg'lā*, Cuba, town, province of La Habana, on Havana Harbor opposite the city of Havana. It is connected with Havana by ferry, with Matanzas and other towns to the east by rail and also has a street railway running to Guanabacoa. It contains foundries, shipyards, and large sugar warehouses, and has a considerable trade, especially in the exporting of sugar. It contains a large bull ring, formerly the scene of the Havana bull fights. Pop. about 14,000.

Regnard, *rē-nār*, **Jean François**, French comic dramatist: b. Paris 1 Feb. 1655; d. Grillon 4 Sept. 1709. He was the son of a rich merchant, and while on a voyage to Italy was captured by pirates and sold as a slave in Algiers. Being redeemed by his family he traveled extensively in Holland, Germany, Poland, and Lapland. He wrote many comedies for the French stage, his masterpiece being '*Le Joueur*' (1696), which holds a place second only to some of Molière's. Other pieces produced at the Théâtre-Française were: '*La Sérénade*' (1694); '*Le Bourgeois de Falaise*' (1696); '*Le Distant*' (1697); '*Democrite*' (1700); '*Le Retour imprévu*' (1700); '*Les Folies amoureuses*' (1704); '*Les Ménechms*' (1705). The best editions of his works are by Didot (1820); Michiels (1854); Fournier (1875); Moland (1893).

Regnault, *rē-nō*, **Alexandre Georges Henri**, French painter: b. Paris 30 Oct. 1843; d. Buzenval 19 Jan. 1871. He was trained in art under Lamothe and Cabanel; in 1866 carried off the Prize of Rome by his '*Thetis Bringing Weapons to Achilles*' and for the next two years lived in Italy, where he furnished illustrations to the '*Travels*' of Francis Weh. He next visited Spain where his passion for light

REGNAULT — REGULAR ARMY

and color was satisfied in studying the works of Goya and Velasquez, of whose 'Las Lanzas' he made a copy. In fact, his first work of importance, a colossal equestrian portrait of General Prim (now in the Louvre) was executed at Madrid. He had a natural, temperamental preference for the features of oriental life, and he loved to paint incidents and scenes of horror. Of such a character is his 'Salome,' a personification of bloodthirsty passion; and 'Decapitation in Granada'; two canvases of marvelous daring in color, but repulsive from their cold brutality. When the war of 1870 broke out he returned to France, enlisted, and was killed at the battle of Buzenvai, near Paris. The circumstances of his death have invested his name with a certain halo of glory in the eyes of his countrymen and have tended to impart an exaggerated importance to his artistic achievements. Consult: Cazalis, 'Henri Regnault, sa Vie et son Œuvre' (1872).

Regnault, Henri Victor, French chemist and physicist: b. Aix-la-Chapelle, Germany, 21 July 1810; d. Auteuil, France, 19 Jan. 1878. After study at the Ecole Polytechnique of Paris, he became a mining engineer and later a professor at Lyons. His 'L'Action du Chlore sur l'Ether Chlorhydrique' (1840) won for him a professorship at the Ecole and admission to the Academy of Sciences. In 1841 he was made professor of physics in the Collège de France. In 1847 chief mining engineer, and in 1854 director of the Sèvres porcelain manufactory. Among his writings, besides many scientific papers in learned journals, are: 'Cours Élémentaire de Chimie' (1849-50; 6th ed. 1870); and 'Premiers Éléments de Chimie' (1850; 6th ed. 1874).

Regnault, Jean Baptiste, French painter: b. Paris 19 Oct. 1754; d. there 12 Nov. 1829. He studied under Bardin and after capturing the Prix de Rome in 1776, entered the Academy in 1783 and became eventually a professor in the Ecole des Beaux Arts (1755). The influence of David was predominant in his day, and Regnault's paintings are all in the conventionally classic manner of that master. Many of his works are in the Louvre, among them his 'Baptism of Christ,' and his most notable picture, the 'Education of Achilles.' He also produced the historically interesting works, 'The Acceptance of the Constitution by Louis XVI.'; 'Napoleon Proclaimed Consul for Life'; 'Battle of Marengo'; and 'The Death of Dessaix.'

Régnier, râ-nê-â, Henri François Joseph de, French poet: b. Honfleur 28 Dec. 1864. He was numbered in his earlier days among the Parnassians and later was allied with Mallarmé and the symbolists. His admirers are found among the younger literary men rather than among the academic. Critics have found his verse excellent for a delicacy of taste and a kind of antique inspiration, but have blamed him for sacrificing too much of the sentiment or the idea to the last refinement of expression. He has published in verse 'Sites' (1887); 'Poèmes anciens, romanesques' (1890); 'Tel qu'en songe' (1892); 'Les Jeux rustiques et divins' (1897); 'Les Médailles d'Argile' (1900); etc., and the novels 'La Canne de Jaspe' (1895); 'Le Trèfle blanc' (1899); 'La double Maîtresse' (1900).

Regnier, Mathurin, French satirist: b. Chartres 21 Dec. 1573; d. Rouen 22 Oct. 1613. He was a nephew of the poet Desportes; served as secretary in Rome to the ambassadors Joyeuse and Béthune. Having taken orders as a youth he was granted a canonry at Rouen upon his return from Rome, but his dissipated habits shortened his life. He was famous for his satires in imitation of Horace, Juvenal and Martial, especially those in which he attacked Malherbe, the reigning literary authority of his day. He showed knowledge of life and character and a power in the expression of manners that in the opinion of Sainte-Beuve ranked him after Montaigne, Ronsard, and Rabelais. No good edition of his works appeared in his lifetime; that published in 1608 and in 1613 was entitled, 'Satires et autres Poésies de Maturin Régnier.' The principal modern editions are those by Viollet-le-Duc (1822); Barthélemy (1862); Courbet (1869 and 1875).

Regular Army. The United States Army, as at present constituted, is organized under the Act of Congress, 2 Feb. 1901. It consists of 15 regiments of cavalry, an artillery corps, 30 batteries of field artillery and 126 batteries of coast artillery, 30 regiments of infantry, 3 battalions of engineers, and an additional provisional force of more than 5,000 men. The total strength of the army is about 66,000 men of whom 3,820 are commissioned officers. The act of 1901 provides that the army shall at no time exceed 100,000 men. The general staff of the army includes one lieutenant-general, Samuel B. M. Young, chief of staff; one major-general, Adna R. Chaffee, two brigadier-generals, three colonels, five lieutenant-colonels, and a number of majors and captains. The army is at present largely employed in keeping order in the Philippines, which constitute a military division, divided into the three departments of Luzon, the Visayas and Mindanao.

At the beginning of the war with Spain in 1898 the United States army numbered only about 26,000 men. Energetic measures, supported by voluntary enlistments in every part of the Union, raised this force at one time to 275,000 men. The war was followed by insurrections in the Philippines, and it was deemed best not to make a sweeping reduction of the regular forces, but to leave such reduction largely to the discretion of the President, who would be guided by events as they should arise in increasing or decreasing the number of men under arms. The bill which became a law made it discretionary with the President, under certain conditions, to increase or decrease the army between fixed limits—a maximum of 100,000 men and a minimum of 60,000, the latter being the peace footing of the organization.

In 1903 a bill was passed providing for a general staff, intended to bind the several branches of the service into one organism, with responsibility concentrated in one officer—the chief of staff. The chief of staff takes the place of the general commanding the army. The President, as commander-in-chief, gives the orders, the chief of staff sees that they are carried out; and in case of war the general staff becomes a war board, the board of strategy to plan and direct campaigns, and is answerable for success or failure of its plans, provided officers and the field do their duty. Under the chief of staff

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is a group of officers selected from the line and staff of all branches of the service, whose duty it is to keep the chief informed in all details of their several departments.

A new militia law was likewise passed in 1903. It provides for the more complete equipment of this section of the service and the establishment of better co-operation between the National Guard and the Regular Army, and it aims at the creation of a National Volunteer reserve. The present strength of the militia is about 109,000 enlisted men and 9,000 officers.

All persons enlisting in the United States army must be not less than 18 nor more than 35 years of age. They must also be of good moral character, temperate habits, able-bodied and free from disease, and able to speak, read and write the English language. Persons under 18, but meeting the other requirements of the service, are accepted for enlistment if they can produce the written consent of parent or guardian. The height and weight requirements are as follows: For infantry and coast artillery, height not less than five feet four inches; weight not less than 120 and not more than 190 pounds. For cavalry and field artillery service the height must be over five feet four inches and under five feet ten inches, and the weight must not be more than 165 pounds. See ARMY, UNITED STATES; MILITARY ACADEMY, UNITED STATES.

Regular Canons of the Immaculate Conception. See ORDERS, RELIGIOUS.

Regular Clerks of the Faith of Jesus. See ORDERS, RELIGIOUS, *Baccanarists*.

Regulars, in the Roman Catholic Church, persons of either sex who are members of any of the religious orders, congregations, or institutes approved by the Holy See. Those of their number who are in holy orders constitute the Regular Clergy, that is, clergy under a religious rule (*regula*), who are bound by the usual three monastic vows: so contradistinguished from the secular clergy—those clergymen who do not belong to such orders or congregations.

Regulators, a name adopted in South Carolina, about ten years before the Revolution, by citizens who organized themselves to put down lawlessness and enforce respect for life and property. Their methods were very like those of the vigilance committees of California and Nevada, about a century later. The Regulators were pacified by the establishment of courts of law in the disturbed districts.

Some years later in North Carolina an organization calling themselves "Regulators" was formed to resist the extortion and oppression practised by officers of the colonial government. They drove out the local authorities, and Governor Tryon led a military force against them, defeating them after a sanguinary battle, near the Allemanee Creek, 16 May 1771. Tryon hanged six of the Regulators for treason. The survivors generally took the patriot side in the War for Independence, and the "Regulator" movement in North Carolina is regarded by some as one of the beginnings of that struggle.

Regulus, rēg'ū-lūs, **Marcus Atilius**, Roman general of the 3d century B.C. He was made consul in 267 B.C., and a second time about 256 B.C. With his colleague, Manlius Vulso, he com-

manded in the first war against Carthage. With a fleet of 330 ships carrying 40,000 men the consuls defeated a superior Carthaginian fleet in the battle of Ecnomus and effected a landing in Africa. Here Regulus followed up his victories so successfully that in a short time he presented himself before the capital of the enemy. Carthage sued for peace and Regulus who wished to end the war before his successor was appointed demanded unconditional submission. The Carthaginians refusing the terms ended the negotiations and at this juncture were joined by a small body of Spartan volunteers under Xanthippus, to whom was given the command of the Carthaginian forces. In a battle under the walls of Carthage 30,000 Romans fell, and Regulus was made prisoner 255. He remained in Carthage till 250, when the Carthaginians, having been defeated at Panormus were desirous of peace. An embassy was therefore sent to Rome, accompanied by Regulus, who was obliged to bind himself by an oath to return to Carthage if Rome should refuse the terms proposed. Regulus, however, advised the continuance of the war and recommended the Romans not to exchange prisoners. Thereupon he declined to listen to the entreaties of his family or of the senate and persisted in his intention to return to Carthage. It is related that he was put to death with great cruelty, and that Hamilcar and Boscar, two noble Carthaginian prisoners, were given up to the family of Regulus, who took revenge on them in a similar manner. Neither the story of the embassy nor of the revenge is related by Polybius, and Ihne, the German historian, inclines to the modern view that the story was invented to excuse the cruelty of the family of Regulus to their prisoners.

Regulus, the star Alpha Leonis, the brightest in the constellation of the Lion.

Re'gur, a dark superficial soil of India, loam or clayey, occurring chiefly on the tableland of the Deccan and in Nagpur, less frequently in Mysore, and reappearing in southern India in continuous sheets from 6 to 20 feet thick. Although generally a surface soil, it dips beneath recent alluvium. It is extremely fertile, having produced heavy crops for many centuries without requiring manure. Its exact age is undetermined. The name is native.

Rehan, rē'an, **Ada** (originally CREHAN), American actress: b. Limerick, Ireland, 22 April 1860. She came to this country as a child and made her first appearance on the stage at 14 in Newark, N. J. She had not at that time, however, taken up acting as a profession, but continued her education in Brooklyn where her parents lived. She appeared for two seasons at Mrs. John Drew's theatre in Philadelphia, and later in stock companies in Baltimore, Albany and Louisville. In 1879 she became a member of Augustine Daly's stock company first as leading lady and afterward as star, where she continued until Daly's death in 1899. Here she took part in many revivals of old comedy, together with a fewer number of modern plays, principally adaptations from the German made by Daly. Her greatest successes were Katharine in 'Taming of the Shrew,' and Lady Teazle in 'School for Scandal,' though she played with acceptance Viola, Portia, Rosalind, and Beatrice, Peggy Shrift in 'The Country Girl,' and Agatha Posket in Pinero's 'The Magistrate.'

Since 1899 she has appeared on the stage only at considerable intervals.

Reich, riĥ, Jacques, American artist: b. in Hungary 10 Aug. 1852. He studied art in Budapest; came to the United States in 1873; continued his art education in New York and Philadelphia; and afterward studied in Paris. He returned to Philadelphia, and became skilled in pen-and-ink drawings and in the etching of portraits on copper. In 1885 he removed to New York. He drew the greater number of the pen-portraits for Scribner's 'Cyclopædia of Painters and Paintings,' and also for Appleton's 'Cyclopædia of American Biography.' His other important work includes a series of portraits of American and English authors and other prominent persons, and half life-size plates of Washington (after the Gilbert Stuart unfinished painting), Jefferson (after the painting by Rembrandt), and President Roosevelt.

Reicha, riĥä, Anton Joseph, Austrian composer: b. Prague, Austria, 27 Feb. 1770; d. Paris, France, 28 May 1836. He made a study of the violin, pianoforte, and flute, and in 1788 he entered the chapel of Maximilian of Austria as second flute. His ambition, however, was to become a composer and after overcoming many difficulties he succeeded in having his symphonies and other compositions played by his uncle's orchestra at the court of the Elector of Cologne. Reicha lived in Hamburg 1794-9 and there wrote his first opera, 'Obaldi, ou les Français en Egypte,' but failed to obtain its production in Hamburg or Paris, though several of his symphonies were well received. In 1802-3 he lived in Vienna, where he enjoyed the patronage of Maria Theresa and was intimate with Beethoven, Haydn, and other great musicians. He removed to Paris in 1808, became professor at the Conservatoire in 1818, was naturalized in 1829, and elected to the Institute in 1835. He was chiefly notable for his chamber music and his theoretical work, though his symphonies and overtures met with considerable success. His operas were lacking in dramatic effect, though their music is excellent. He was also author of numerous theoretical works, among which may be mentioned: 'Traité de Melodie' (1814); 'Traité de haute Composition musicale' (1818); 'Art du Compositeur dramatique' (1833); etc.

Reichardt, riĥärt, Johann Friedrich, German composer and author: b. Königsberg 25 Nov. 1752; d. Giebichenstein 17 June 1814. He studied in the universities of Königsberg and Leipsic; was appointed Kapellmeister by Frederick the Great, and during his tenure of office introduced Concerts Spirituels for the performance of novelties with analytical programs. He conducted Italian opera under Friedrich Wilhelm II., but his French sympathies brought about his dismissal in 1794. He was court director at Cassel for a short time during the incumbency of the king of Westphalia. He holds an important place in the history of music from the fact that his Singspiele are factors in the development of German opera, and his Lieder are among the earliest of their kind. He wrote operas, oratorios, and cantatas, besides compositions for orchestra and pianoforte, and set to music Bürger's translation of Macbeth, Goethe's Faust, Egmont, and Tasso, besides many lyrics. He edited musical periodicals and

published familiar letters describing his travels ('Vertraute Briefe,' 1810).

Reichenbach, riĥen-bāĥ, Karl, BARON VON, German naturalist: b. Stuttgart 12 Feb. 1788; d. Leipsic 19 Jan. 1869. He studied at Tübingen, where he obtained the degree of doctor of philosophy, and was denounced to the Napoleonic police and imprisoned for having organized an association with the fanciful object of founding a German kingdom in the South Seas. He visited the principal iron works in France and Germany, and established others of his own at Villingen, and the first large German charcoal-burning establishment at Hausach in Baden. In 1821 he founded with Count Hugo zu Salm, a number of industrial establishments in Moravia, from which he realized a considerable fortune. The king of Würtemberg raised him to the dignity of baron in 1839. In 1834 he published in Vienna 'Mittheilungen aus Mähren,' the first geological monograph in Austria. He is also credited with some chemical discoveries, in particular of paraffin and cresote. In the course of his studies of animal magnetism he believed he had discovered a new force, which he called *od* and upon which he published several works, as 'Odisch-magnetische Briefe' (1852); 'Der sensitive Mensch und sein Verhalten zum Ode' (1854). *Od*, he said, was a peculiar power possessed by certain persons of special sensitiveness, which enabled them to detect veins of ore, distinguish negative and positive magnetic poles, start a pendulum without touching it, and the like. He derived the word from the Latin *vado*, 'I go quickly.' Part of the scientific world attacked his theory, but the larger portion laughed it out of court; and after his death it was quite forgotten. Reichenbach's latest works were 'Köhlerglaube' and 'Afterwissenschaft,' in reply to Karl Vogt (1856); 'Aphorismen über Sensibilität und Od' (1866); 'Die odische Lohe' (1867).

Reichenbach, Saxony, 11 miles southwest of and in the circle of Zwickau, is a manufacturing town, trading considerably in woolen and cotton goods. This is the home of the distinguished antiquary, Böttiger (q.v.). Pop. about 26,000.

Reichenberg, riĥen-bérg, Austria, town in Bohemia; on the Neisse; about 60 miles in direct line north-northeast of Prague (q.v.). It is a well-built town with several modern public buildings and a number of historic edifices dating back to the 13th and 14th centuries. It is one of the leading manufacturing towns of Austria. The chief manufactures are woolen, cotton, and linen goods, carpets, leather, shoes, hats, gold, and silver ware, musical instruments, and firearms. The schools rank high; it has an excellent industrial school.

Reichmann, riĥmān, Theodor, German opera singer: b. Rostock, Mecklenburg, 18 March 1849; d. Vienna, Austria, 23 May 1903. He studied at Berlin, Prague, and Milan, and became widely known on the German operatic stage as a dramatic baritone. In 1882 he began his engagement at the Vienna Opera House, and in that year created the part of Amfortas in 'Parsifal' at Baireuth. He continued at the Vienna Opera House with great success until 1889, when he came to New York and made his first appearance at the Metropolitan Opera

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House in 'The Flying Dutchman.' His reception there was most flattering, and his success was marked throughout his engagements there in 1889-90, 1890-1. He possessed a remarkable voice; and his dramatic impersonation of his various roles made him one of the most famous operatic singers of his day. He was notable in his presentation of the roles: William Tell, Wolfram, Wotan (in 'Siegfried'), Nelusko (in 'L'Africaine'), etc.

Reichsrath, *rīhs'rāt*, the representative council of the empire of Austria. See AUSTRIA.

Reichstadt, *rīh'stāt*, **Duke of** (NAPOLEON FRANÇOIS CHARLES JOSEPH BONAPARTE), titular emperor of France: b. Paris 20 March 1811; d. Schönbrunn, Austria, 22 July 1832. He was son of Emperor Napoleon I. (q.v.), and from his birth was styled "king of Rome." After his father's first abdication in 1814 he went with his mother to Vienna. After Waterloo, Napoleon proclaimed him Napoleon II. (22 June 1815). He was brought up at the court of his grandfather, the Emperor Francis, who created him Duke of Reichstadt (1818). His education was careful, and he was early trained to the military profession. After passing through subordinate grades he was made a lieutenant-colonel in June 1831, and took command of a battalion in the Gyulai regiment of Hungarian infantry, then garrisoned at Vienna. He was extremely attentive to his military duties, but he had grown very tall and slender, and symptoms of consumption had early shown themselves. His physician advised a removal to Schönbrunn, but this proved unavailing. The Duke is said to have possessed rare linguistic powers. He was made the hero of 'L'Aiglon' ('The Eaglet'), a drama by Edmond Rostand (q.v.). Upon the accession of Napoleon III. (q.v.), he was reckoned among French sovereigns as Napoleon II. Consult: Welschinger, 'Le Roi de Rome' (1879); Lacroix, 'Le Roi de Rome' (1899); Wertheimer, 'Der Herzog von Rom' (1902).

Reichstag, *rīhs'täg*, the representative legislative body of the German nation as a whole. The Bundesrath is of the separate German states. The president of the Reichstag is elected by the deputies. See GERMANY.

Reid, *rēd*, **Sir George**, Scottish artist: b. Aberdeen, Scotland, 31 Oct. 1841. He studied art in Edinburgh, Utrecht, Paris, and The Hague, being the pupil in turn of Mollinger, Israels, and Yvon. In 1891 he was elected president, in succession to Douglas, of the Royal Scottish Academy. He is widely known for his fine portraits. He is also distinguished as a flower and landscape painter and is a book illustrator of no mean merit.

Reid, **George Agnew**, Canadian painter: b. near Wingham, Ontario, 1861. At Paris he was a pupil of Constant, Lefebvre, and Dagnan-Bouveret and became a constant exhibitor at the Salon. The World's Fair Columbian medal was awarded to his 'The Foreclosure of the Mortgage' (1893). He has been successful in panel decoration and the series in the entrance hall of the Municipal Buildings, Toronto, contain very good examples of his style. In 1898 he was elected president of the Ontario Society of Artists.

Reid (Thomas), Mayne, British author of tales of adventure: b. Ballyroney, County Down, Ireland, 4 April 1818; d. near Ross, Herefordshire, England, 22 Oct. 1883. The son of a Presbyterian minister he was educated for the ministry, but love of adventure took him to this country, where he engaged in various callings, and traveled widely as hunter and trader. In 1843 he was a journalist in Philadelphia, but joined the United States army as a volunteer in 1846 and fought in the Mexican War, his experiences in which furnished him with materials utilized in several novels. He afterward went to London and became well known as a writer of thrilling stories, many of them based on his American experiences, such as 'The Rifle Rangers'; 'Scalp Hunters'; 'The War Trail'; 'The Headless Horseman'; etc. He returned to America in 1867 and founded the 'Onward Magazine,' which was unsuccessful, and in 1870 went back to England. Many of his tales were translated into French and German. They were all very readable and healthy in tone, though extravagant in incident. Consult 'Memoir' by his wife (1890).

Reid, Robert, American painter: b. Stockbridge, Mass., 1863. His work shows the influence of Impressionism, but as the pupil of Boulanger and Lefebvre in Paris, where he began his art studies, he maintains an academic correctness, and insistence upon detail which render his work singularly effective. His great decorative piece in the Paris Exposition of 1900 ('America Unveiling Her Natural Strength') was much admired, and like all his productions in this department has extended his reputation.

Reid, Robert Gillespie, a Newfoundland railway contractor: b. Coupar-Angus, Scotland, about 1840. In 1865 he went to Australia, where he took part in gold-mining and public works; in 1871 came to America, and later constructed many important railways in the United States and Canada. The heaviest section of the Canadian Pacific was built by him; and he was prominent also in bridge-work, constructing the international railway bridge over the Rio Grande, the international bridge across the Niagara, and (1886) the Lachine bridge, traversing the Saint Lawrence, three fourths of a mile in length. In 1893 he made with the colony of Newfoundland a contract whereby he was to build a railway from Saint John's to Port-au-Basque to be completed in three years at \$15,600 per mile. For the further consideration of a land-grant of 5,000 acres per mile of construction, he was to maintain and operate the railway for 10 years. He contracted with the colonial government in 1898 to operate all the railways of the island for 50 years, maintaining them in a safe and efficient manner, on condition that the railways should become his property at the end of that period. He was to obtain also 2,500,000 acres of land-concessions additional, and the government land telegraph lines. On his part he contracted also to build and operate seven steamers transporting passengers and goods at various points in the island; to buy and operate the Saint John's dry-dock; to build and operate an electric street-railway in Saint John's; to pave a specified portion of Saint John's; and to pay \$1,000,000 within one year from the date of the signing of the contract. In fact, he became the real owner of the island, and was popularly known as "Czar" Reid.

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Sir Robert Bond, the Liberal leader, protested against the contract, and Reid was finally obliged to transfer his property to the Reid Newfoundland Company, while adjustment of the contract was made favorable to the government.

Reid, Samuel Chester, American naval officer: b. Norwich, Conn., 25 Aug. 1783; d. New York 28 Jan. 1861. He entered the United States navy as a midshipman when very young, rose rapidly in rank and in the War of 1812 commanded the privateer General Armstrong. He repulsed the British attack in the harbor of Fayal, Azore Islands, 26 Sept. 1814, the enemy having three vessels with 2,000 men to his single vessel with 90 men. During 10 hours' fighting, the British lost 300 killed and wounded and the Americans two killed and seven wounded. Reid was subsequently harbormaster and warden of the port of New York. He invented a signal telegraph, reorganized the pilot-boat system, established a lightship off Sandy Hook, and designed the present flag of the United States, first used in 1818, suggesting the retention of the original 13 stripes and the addition of a star for each new State.

Reid, Thomas, Scottish metaphysician: b. Strachan, Kincardineshire, 26 April 1710; d. Glasgow 7 Oct. 1796. He was graduated at Marischal College, Aberdeen, in 1726, and in 1736 presented to the neighboring living of New Machar. It was his custom to preach the sermons of Tillotson and Evans rather than his own compositions, for he was already chiefly absorbed in the study of metaphysics. In 1748 he published a paper in the London 'Philosophical Transactions,' in which he opposed the introduction of mathematical formulas into metaphysical and moral speculations, and particularly criticized the statement of Hutcheson that the benevolence or moral merit of an agent is "proportional to a fraction having the moment of good for the numerator, and the ability of the agent for the denominator." He was elected in 1752 professor of philosophy in King's College, his department comprehending logic, ethics, mathematics, and physics. His 'Inquiry into the Human Mind on the Principles of Common Sense' (1764) aimed at the refutation of Hume's skeptical theory. Affirming the impossibility of proving the existence of an external world from reason, or experience, or instruction, or habit, or any other principle hitherto known to philosophers, Reid introduced the doctrine of an original instinct or "common sense" (q.v.) as the ground of the belief. In 1764 he was transferred to the University of Glasgow as successor of Adam Smith in the chair of moral philosophy. His course included metaphysics, moral philosophy, natural law, and political right. He was a member of a philosophical society before which he read several essays, including an 'Examination of Dr. Priestley's Opinion Concerning Matter and Mind,' 'Observations on the Utopia of Sir Thomas More,' and 'Physiological Reflections on Muscular Motion.' In 1781 he withdrew from public duties to devote himself exclusively to philosophical studies. In 1785 he published 'Essays on the Intellectual Powers of Man,' consisting of his academical lectures, and in 1788 his 'Essays on the Active Powers of Man,' his last important work. An edition of his works with notes and dissertations was pre-

pared by Sir William Hamilton (incomplete, 1846). Consult: Ferries, 'Reid and the Philosophy of Common Sense' (1866).

Reid, Sir Thomas Wemyss, English journalist: b. Newcastle-on-Tyne 1842; d. London 26 Feb. 1905. He contributed frequently to English reviews and magazines, edited the Leeds 'Mercury' (1870-1887), and 'The Speaker' from 1890 to 1899, when he resigned and published: 'Cabinet Portraits: Sketches of Leading Statesmen of Both Parties' (1872); 'Charlotte Brontë: A Monograph' (1877); 'The Land of the Bey' (1882); 'Mauleverer's Millions' (1885); 'Life of William Edward Forster' (1888); 'Life of Lord Playfair' (1899); 'Life of W. E. Gladstone' (1899); 'William Black: a Biography' (1902); etc.

Reid, Whitelaw, American journalist: b. Xenia, Ohio, 27 Oct. 1837. He was graduated from Miami University in 1856; and began his journalistic career as editor of the *Xenia News*, in 1858-9. In 1860 he became a reporter for the *Cincinnati Gazette*, in 1861-2 was war correspondent, and later Washington correspondent for the same paper, the brilliancy and accuracy of his war reports attracting considerable attention among newspaper men. He was aide-de-camp on the staff of Gen. Morris and Gen. Rosecrans in West Virginia. In 1863-6 he was librarian of the House of Representatives and after the war spent some time on a cotton plantation in Concordia Parish, La. In 1868 he joined the editorial staff of the *New York Tribune*; in 1869 became managing editor; and in 1872 editor-in-chief. Under his management the *Tribune* has come to rank among the leading papers of the city in the trustworthiness of its news reports. He twice declined an appointment as minister to Germany, was minister to France in 1889-92 and negotiated important reciprocity treaties, and in 1892 was the unsuccessful Republican candidate for Vice-President. He was the special ambassador from the United States to Queen Victoria's jubilee in 1897; was a member of the American-Spanish peace commission in Paris in 1898; and was special ambassador at the coronation of Edward VII. in 1902. In April 1905 he was appointed ambassador to the Court of Saint James, to succeed Joseph H. Choate. He has been a regent of the University of New York since 1878. He has written: 'After the War, a Southern Tour' (1867); 'Ohio in the War' (1868), an important contribution to the local history of the State; 'Schools of Journalism' (1870); 'The Scholar in Politics' (1873); 'Newspaper Tendencies' (1874); 'Town Hall Suggestions' (1881); 'Two Speeches at the Queen's Jubilee' (1897); 'Some Consequences of the Late Treaty of Paris' (1899); 'Our New Duties' (1899); 'A Continental Union' (1900); 'Our New Interests' (1900); and 'Problems of Expansion' (1900).

Reid, Sir William, Scottish meteorologist and colonial governor: b. Kinglassie, Fifeshire, 1791; d. London 21 Oct. 1858. He was educated at the Royal Academy at Woolwich, and in 1809 entered the army as lieutenant of engineers, serving in the Peninsular campaign under Wellington, in America in the War of 1812, and in Belgium in 1815. He was appointed governor of Bermuda in 1838 and by his excellent

administration of affairs greatly improved the deplorable agricultural condition of the island. He opened a market for their products in New York and by these and other efficient methods gained the title of "the good governor." In 1846 he became governor of the Windward Islands and in 1848 he returned to England and was appointed commanding engineer at Woolwich. In 1851 he was knighted and appointed governor of Malta, where he remained until 1858. He was raised to the rank of major-general in 1856. He became interested in meteorology in 1831 while superintending the repair of injuries inflicted by a severe hurricane at Barbados and engaged in a correspondence with William C. Redfield (q.v.) of Yale College. The correspondence has since been presented to Yale. He was elected a member of the Royal Society in 1839. His publications include: 'An Attempt to Develop the Law of Storms by Means of Facts Arranged According to Place and Time' (1838); and 'The Progress of the Development of the Law of Storms' (1849).

Reid, William Thomas, American educator: b. near Jacksonville, Ill., 8 Nov. 1843. He served in the Union army during the Civil War, was graduated from Harvard in 1868 and was headmaster of the High School, Newport, R. I., 1868-71. He subsequently taught in the Boston Latin School, was superintendent of the Brookline, Mass., schools 1873-5, was principal of the San Francisco Boys' High School 1875-81, and president of the University of California 1881-5. He founded the Belmont School for Boys at Belmont, Cal., the most important college preparatory school on the Pacific coast, and is its present (1904) headmaster. Consult: Adams, 'Some Famous American Schools' (1903).

Reighard, rīgārd, Jacob Ellsworth, American educator: b. Laporte, Ind., 2 July 1861. He was graduated in 1882 from the University of Michigan; studied also at Freiburg-im-Breisgau; was assistant professor of zoology at the University of Michigan in 1887-8 and 1890-2; and directed the scientific work of the Michigan Fish Commission in 1890-4. In 1898 he was placed in charge of the biological survey of the Great Lakes for the United States Fish Commission. From 1892 he held the chair of zoology in the University of Michigan. He wrote 'The Anatomy of the Cat' (with H. S. Jennings, 1901).

Reign of Terror, a period of the French Revolution, conspicuous for its horrors and cruelties. It is generally considered to extend from 21 Jan. 1793, the date of the execution of Louis XIV., to 28 July 1794, when Robespierre and other sanguinary leaders were guillotined. Every day, during the Reign of Terror, victims were hurried, after a mock trial, to the scaffold, and the prisons were kept replenished by fresh captives from all parts of France. When all the nobility who could be reached had been cut off, the middle and lower classes were drawn upon for victims, and the terrorists even laid traps for each other, in their mad ambition and fear of what the future might be. At last a successful *coup d'état* was secretly organized, which resulted in the extermination of the more rabid revolutionists, and the lifting of the awful nightmare which had brooded for months over France. The Reign of Terror had its reaction

in the despotism of Napoleon, and eventually in the restoration of the Bourbons.

Reikiavik, rīkē-ā-vīk, or Reykjavik, rik'-yā'vīk (Dan. REIKEVIG), Iceland, capital of the island, stands on the southwestern coast and is an important northern port from which considerable trade is carried on. The climate is not very severe as generally supposed. The people are unusually intelligent; the chief institutions include a public library, churches, schools. A great fair is held annually.

Reimarus, rī-mā'roos, Hermann Samuel, German scholar: b. Hamburg 22 Dec. 1694; d. there 1 March 1768. From about 1714 he studied at Jena, and afterward lectured at Wittenberg. He became in 1723 rector at Wismar, and in 1728 was appointed to the professorship of Hebrew in the Gymnasium of Hamburg, which he subsequently united with the professorship of mathematics. He edited the works and wrote the life of his father-in-law, 'De Vita et Scriptis J. Alb. Fabricii Commentarius' (1737). The edition of Dio Cassius, begun by Fabricius and ended by him, shows him as a philologist in a favorable light. Among his further publications are: 'Die vornehmsten Wahrheiten der natürlichen Religion' (1754); 'Betrachtungen über die Kunsttriebe der Thiere' (1762); and 'Vernunftlehre' (1756). In the 'Wolfenbüttelsche Fragmenten eines Ungenannten' (published by Lessing in 1777-8) he made an application of the rules laid down in the last-mentioned work against the positive doctrines of Christianity. Until published by Lessing it was known only in manuscript to a few of his most intimate friends. It precipitated the well-known controversy between Lessing and Pastor Goeze of Hamburg. See LESSING.

Reims, rēmz. See RHEIMS.

Reinach, rā-nāk, Joseph, French publicist and politician: b. Paris 30 Sept. 1856. He studied law at the University and was admitted to the bar in 1877, in 1881 became secretary to Gambetta and continued such until the fall of that minister. Having earlier devoted considerable time to journalism, he returned to that field in 1886, becoming proprietor with Denayrouse of 'La Republique Française.' In 1889 he was elected deputy by the arrondissement of Digne, and was re-elected in 1893, but owing to his attitude of criticism of the Dreyfus trial and his demand for a revision, he failed of re-election in 1898. He published a number of pamphlets on this celebrated case. He is also the author of 'La Servie et la Monténégro' (1876); 'Voyage en Orient' (1879); 'Le Ministère Gambetta, Histoire et Doctrine' (1884); 'Etudes de Littérature et d'Histoire' (1838-9); 'La Politique Opportuniste' (1890); 'Petites Catilinaires' (1888-9), being his articles against Boulanger published in 'Republique Française.' He edited 'Discours et Plaidoyers politiques de Gambetta' (1881-5), and 'Dépêches Circulaires, Decrets, Proclamations et Discours de Gambetta' (1870-1).

Reinach, Salomon, French archæologist, brother of Joseph Reinach (q.v.): b. Saint-Germain-en-Laye 21 April 1858. He was educated at the Lycée Fontanes and the Ecole Normale Supérieure and was appointed to the Ecole Française d'Athènes. He made a series of excavations and investigations at Myrina near Smyrna

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in 1880-2 and in 1886 was an attaché at the Museum of National Antiquities at Saint-Germain-en-Laye. In 1890-2 he was assistant professor of archaeology at the Ecole du Louvre, was associate curator of the National Museums in 1893 and in 1896 was elected to the Académie des Inscriptions et Belles-Lettres. He has published: 'Chronique d'Orient' (1885-91); 'Description raisonnée du Musée de Saint-Germain' (1890); 'Répertoire de la Statuaire grecque et romaine' (1897-8); 'Guide illustré du Musée national de Saint-Germain' (1899); etc.

Reinbold, rin'bôlt, Adelheid. See BERTHOLD, FRANZ.

Reindeer, a very distinct genus *Rangifer*, of *Cervidae*, unique in the possession of antlers by both sexes, though those of the female are somewhat smaller. The Euro-Asiatic reindeer (*Rangifer tarandus*), is the only domesticated species of the family. It extends over the boreal regions of the eastern hemisphere between about lat. 50° and 81°, and runs into several well marked varieties. The reindeer formerly had a much wider geographical range, and is probably the *bos cervi figura* described by Cæsar as inhabiting the Hercynian forests. Its remains are found associated with hippopotami in Pleistocene formations still farther south in Europe. The antlers are not alike on both sides, the great palmated brow tine being, as a rule, developed on one side only. In the winter the fur is long, grayish brown on the body; neck, hind-quarters, and belly white. In summer the gray hair darkens into a sooty brown, and the white parts become gray, owing to the shedding of the long hairs. To the Laplander the reindeer serves as a substitute for the horse, the cow, the sheep, and the goat. It is extensively employed as a beast of draft and carriage, being broken to draw sledges, or to carry men or packages on its back; the large race of Siberia and Kamchatka being used especially for the latter purpose. A full-grown animal can draw a weight of 300 pounds, and travel at the rate of 100 miles a day, its broad deeply cleft hoofs fitting it admirably for traveling over the broken snow. In winter the herds feed in the woods on the lichens which hang from the trees, or grow upon the ground, to secure which the shovel-like brow tine and the hoofs are employed to scrape away the snow; in summer they move to the valleys to feed on the herbage and shoots, and in autumn they seek the sea coast in order to escape the mosquitoes and gad-flies, where they feed largely upon marine algæ cast upon the shore. So important are these animals to the Laplanders that they, with their entire households, accompany them on these annual migrations. In 1891 16 head of domestic reindeer were introduced into Alaska by Dr. Sheldon Jackson for the benefit of the natives who frequently suffered for food, and for purposes of transportation. The experiment proved so satisfactory that larger importations were made in subsequent years and the number in Alaska has now reached about 10,000. In 1898 Dr. Jackson, as agent of the United States government, procured a colony of Laplanders to train the natives in the care of the reindeer. The Esquimos are the chief owners and their herds promise to become a material source of wealth. Whether alive or dead every product of the reindeer serves a useful purpose.

By European mammalogists the American wild reindeer or caribou, as they are called, are considered to be co-specific with *R. tarandus*, but American students recognize two native species with some six or seven sub-species. The woodland caribou (*R. caribou*) inhabits the wooded parts of British America and the United States border from Maine to Minnesota. It is larger than most varieties of the European reindeer, and both the brow and bez tines of the antlers are much palmated; those of the female are much smaller and little palmated. It frequents marshy regions, and feeds upon leaves, grass and shoots, but in some localities at least, migrates northward in the winter in search of tree lichens (*Usnea*, etc.) and reindeer moss (*Cladonia rangiferina*). The latter is a valuable lichen, which grows in great abundance in the north of Europe, particularly in Lapland, as well as on the tundras of Siberia and the barren plains of Arctic America. It constitutes almost the sole winter food of the reindeer. Linnæus says it grows so luxuriously in Lapland that it sometimes reaches a foot in height. The reindeers scratch it up from under the snow with their feet and antlers. On this plant their existence, as well as that of the Laplanders, to whom they are indispensable, depends. Its nutritive properties depend chiefly on the gelatinous and starchy matter of which it is largely composed. Its taste is slightly pungent and acid. When boiled it forms a jelly possessing nutritive and tonic properties.

The Barren Ground caribou (*R. arcticus*) is a smaller species with larger antlers which occupies the more central and northern barren plains of British America. This species lives in herds of enormous size, said to rival even those of the bison of former days, and migrates regularly. In the winter it moves southward to the wooded belt where it meets but does not mix with the woodland caribou, and in the spring returns to the shores of the Arctic Ocean. See CARIBOU.

Much interesting information concerning the habits of reindeer will be found in the narratives of Nordenskjöld and other Arctic travelers. Besides these consult Caton, 'Antelope and Deer of North America' (Boston, 1881); Lydekker, 'Deer of All Lands' (London, 1898); Richardson, 'Fauna Boreali-Americana' (London, 1829); Jackson, 'Annual Reports on Reindeer in Alaska' (Bureau of Education, Washington, 1892).

Reindeer Moss. See REINDEER.

Reinecke, ri'něk-ě, Karl, German musician: b. Altona, Prussia, 23 June 1824. He was educated by his father, a composer, and in 1834 made a successful concert tour as a pianist, later becoming court pianist to the king of Denmark. He was appointed a teacher in the Cologne Conservatory in 1851, and in 1860 was made professor of piano and composition in the Leipzig Conservatory. He has become well known as a director and as a pianist and for his interpretations of Mozart. His compositions number nearly 200, are characterized by great refinement and have a distinctly classical and occasionally a romantic touch. They include: 'Serenade'; 'Aus der Jugendzeit'; 'König Manfred' (1867); 'Auf hohen Befehl' (1886); 'Der Gouverneur von Tours' (1891); etc.

Reinhart, rin'härt, Benjamin Franklin, American artist: b. Waynesburg, Pa., 29 Aug. 1829; d. Philadelphia 3 May 1885. At 15 he began to study art, and afterward took a three years' course at the National Academy, New York. In 1850 he went to Europe and studied in Paris and Düsseldorf. Returning to this country, he settled in New York in 1868. His most important works are engravings, and include: 'Cleopatra' (1865); 'Washington Receiving the News of Arnold's Treason'; 'After the Crucifixion' (1875); 'Evangeline' and 'Pocahontas' (1877); 'The Pride of the Village'; and 'Captain and the Governor' (1884); etc. To these should be added portraits of the Princess of Wales, Duchess of Newcastle, Carlyle, Tennyson, Charles O'Connor, James Buchanan, Gen. Winfield Scott, Stephen A. Douglas, and others.

Reinhart, Charles Stanley, American artist: b. Pittsburg, 16 May 1844; d. Philadelphia 30 Aug. 1896. He went to Paris in 1867 and studied at the Atelier Suisse; in 1868 entered the Royal Academy in Munich; and in 1870 returned to the United States. Besides noteworthy illustrations for magazines in this country and in Europe, he produced works in black-and-white, water-color, and oil, many of which were exhibited at the National Academy. In 1881 he again went to Paris where he resided till 1891, and was a regular exhibitor at the Salon. Later he became a member of the Society of American Artists, New York. Among his works in black-and-white are 'An American Abroad,' 'A Little Swiss Sojourn,' and 'Reichstag Sketches'; in water-color, 'Gathering Wood' (1877); 'At the Ferry' (1878), and 'The Spanish Barber' (1884); in oil, 'The Old Life-Boat' (1880); 'Washed Ashore' (1887); and 'The Rising Tide' (1888).

Reinhart, Johann Christian, German painter: b. near Hof 24 Jan. 1761; d. Rome 8 June 1847. He began his professional education as a divinity student in Leipsic theological school, but soon showed a very decided inclination for art and became a pupil of Oeser. He afterward attended the Academy of Dresden. The liberality of his patron, the Margrave of Baireuth, enabled him to visit Rome, where he fixed his residence. His compositions are rich, nobly conceived, and full of poetic beauties, but his coloring is wanting in softness and warmth. Of the great masters he most strongly resembles Swanevelt. Among the most excellent paintings of his later years are those in the Massini Palace at Rome. He was also successful as an etcher. Consult: Baisch, 'J. Ch. Reinhart und seine Kreise' (1882).

Reinhold, rin'hölt, Karl Leonard, German philosopher: b. Vienna 26 Oct. 1758; d. Kiel 10 April 1823. His parents destined him for the church, and sent him to study with the Jesuits in Vienna. When the order was abolished in 1774 he entered the college of the regular priests of St. Paul (generally called Barnabites), where he became, at 22, professor of philosophy. He left Austria in 1787, and the same year was appointed professor at Jena, having written a celebrated vindication of the Reformation against two chapters in Schmidt's 'History of the Germans.' In 1794 he became professor at Kiel and remained there until his death. Among his other works are 'Über das Funda-

ment des philosophischen Wissens' (1791); 'Grundlegung einer Synonymik für den allgemeinen Sprachgebrauch in den philosophischen Wissenschaften' (1812). In his philosophy he followed Kant, Fichte, Bardili, and Jacobi. Consult 'Life' by his son E. Reinhold (1825).

Reinick, ri'nik, Robert, German artist and poet: b. Dantzic, Prussia, 22 Feb. 1805; d. Dresden 7 Feb. 1852. He studied painting in Berlin under Begas, and at the Düsseldorf Academy, and in 1844 settled at Dresden. He displayed superior artistic powers in romantic and historical subjects, and especially in such works as show the artistic union of brush and pen. Among his more important productions in art are 'Rachel and Jacob at the Well'; 'Well Near Olevano'; and numerous etchings contributed to various publications. To Rethef's 'Dance of Death' he furnished the poetical text and his other writings include: 'Song-book for Artists' (1833); 'Song-book of a Painter' (1837-44); 'Songs and Fables for the Young' (1844); Hebel's 'Allemanic Poems' (1851) which he translated into High German; 'Collected Songs' (1852); and 'Book of Poetic Fables and Stories.'

Reinicke, ri'nik-ë, Paul René, German painter and designer: b. Strenz-Naundorf, near Halle, 1860. Beginning his professional life at Weimar in the studio of A. Struys, he afterward became a pupil of E. von Gebhardt at Düsseldorf. In order to extend still further his art experience he went to Palestine as a pupil and assistant of Piglhein, at that time painting his panorama of the 'Crucifixion of Christ,' and executed a considerable portion of that work. While his promise as a painter was very evident he abandoned the easel on returning to Munich and became chief illustrator for the 'Fliegende Blätter.' The wonderful skill he has shown in this department of art is well known and he has depicted aristocratic life in park and promenade, ballroom and theatre, with a truthfulness and grace, with a suggestive wealth of detail and consummate finish of execution which are unrivaled. A collection of his designs, under the title 'Spiegelbilder aus dem Leben' ('Reflections from Life') has appeared in heliogravure (1890).

Reinkens, rin'këns, Joseph Hubert, German Old Catholic bishop: b. Burtscheid, near Aix-la-Chapelle, Germany, 1 March 1821; d. Bonn 5 Jan. 1896. He was educated at Bonn and Munich, was ordained to the Roman Catholic priesthood in 1847, and became professor at Breslau in 1853. In 1870 he protested against the infallibility dogma and was suspended from his clerical offices and in 1872 was excommunicated. He became one of the leaders of the Old Catholic movement and in 1873 he was consecrated bishop of the Old Catholic Church with his official residence at Bonn and was recognized as such by the German government. He published: 'Hilarius von Poitiers' (1864); 'Revolution und Kirche' (1876); 'Lessing über Toleranz' (1883); etc.

Reinsch, rinch, Paul Samuel, American historian and educator: b. Milwaukee, Wis., 1869. He was graduated from the University of Wisconsin in 1892, from its law department in 1894 and after studying abroad, became professor of political science at the University of Wisconsin

REIS EFFENDI—RELATIVITY

in 1899. He is the author of: 'The Common Law in the Early American Colonies' (1899); 'World Politics at the End of the 19th Century as Influenced by the Oriental Situation' (1900); 'Colonial Government' (1901); 'Colonial Administration' (1903); etc.

Reis Effendi. See EFFENDI.

Reiske, ris'kè, Johann Jakob, German philologist: b. Zörbig, Saxony, 25 Dec. 1716; d. Leipsic 14 Aug. 1774. He was educated at the University of Leipsic and devoted much attention to the study of the Semitic languages, particularly Arabic. Although abjectly poor he journeyed to Leyden where he gained access to the library and continued his study of Arabic. In 1758 he was appointed to a rectorship at the Nikolai Gymnasium at Leipsic, a position he occupied until his death, devoting himself to Greek literature in regard to which he became an authority. His works display a wide erudition and he succeeded in attracting public attention to the value of Arabic literature in the world of learning. He edited: 'Theocritus' (1765-6); 'Maximus Tyrius' (1774-5); 'Plutarch' (12 vols. 1774-82); etc.; translated from the Arabic and Greek classics and made the Latin translation of Abulfeda's 'Annales Moslemici' (1754). Most important among his writings is 'Animadversiones in Græcos Auctores' (6 vols. 1757-66). Consult: 'Autobiography,' edited and completed by his wife (1738); Morus, 'Vita Reiskii' (1777); Haupt, 'Opuscula' (1875-6).

Reit'boks, or Reedbucks, a genus (*Cervicapra*) of small South African antelopes, which have horns only on the heads of the males, and are never found far from water, affecting particularly marshy valleys and the reedy borders of the larger rivers. The type is *C. arundineum*. Other species are the roi rhebok, nagor and bohor.

Réjane, rā-zhân, Madame, stage-name of GABRIELLE (RÉJU) POREL, French actress: b. Paris 6 June 1857. She first appeared in 1875 in 'Revue des Deux Mondes' at the Vaudeville. She became known for her impersonation in melodramatic parts, particularly in the title-role of 'Madame Sans Gêne' (1893), written for her by Sardou. In 1895 she toured in the United States with much success. One of her later appearances was in 'La Passerelle' at the Vaudeville.

Rejected Addresses, a famous collection of parodies by the brothers James and Horace Smith, which was issued anonymously in 1812, and met with great success. They were written as a burlesque upon the many prominent and unsuccessful competitors for the reward offered by the management of the Drury Lane for an address to be delivered at the opening of the new theatre. Among the parodies the following are the work of James Smith: 'The Baby's Début' (Wordsworth); 'The Hampshire Farmer's Address' (Cobbett); 'The Rebuilding' (Southey); 'Play-House Musings' (Coleridge); 'The Theatre' (Crabbe); the first stanza of 'Cui Bono' (Lord Byron); the song entitled 'Drury Lane Hustings'; and 'The Theatrical Alarm-Bell,' an imitation of the Morning Post; also travesties on 'Macbeth,' 'George Barnwell,' and 'The Stranger.' The rest are by Horace Smith. The 'Rejected Addresses' still hold a high place

among the best works of their kind ever written, and their extent and variety exhibit the versatility of the authors.

Relapsing Fever, a disease so called from the fact that during apparent convalescence a relapse of all the symptoms occurs; and this may be repeated more than once. It is also called famine fever, because it has occurred during seasons of destitution since 1739. Other names for it are seven-day fever and *febris recurrens*. It is infectious and contagious. The symptoms do not usually show themselves for three or four days after exposure to the contagion. They generally begin in a shivering sensation, with headache, and with muscular pains all over the body, but especially in the limbs; then the pulse rises, and the temperature increases; there is also great thirst, pain over the stomach, and retching. Sometimes there is intense hunger, and the patient becomes extremely prostrated. On the 5th or 7th day the symptoms abate, and there is rapid amendment until about the 14th or 15th day from the beginning of the symptoms, when a relapse occurs. Three or four days afterward convalescence again begins, and in the majority of cases it goes on to complete restoration of health. Relapsing fever is not often fatal, the death-rate being about two per cent of those attacked. The treatment consists in giving gentle laxatives and cooling drinks, a light nutritious diet, and in securing to the patient perfect quietness. Relapsing fever is known to be caused by a spirillum (*Spirochæta obermeieri*), a micro-organism which Obermeier of Berlin showed (1873) to be constantly present in the blood of those having this disease.

Relativity. The relative is that which exists in and through its relation to something else, as opposed to the absolute, which is in and for itself. It follows, then, that every finite thing possesses only relative reality; for it is determined in all aspects of its existence by its relation to other things. Only what is infinite, and so all-inclusive, can be absolute. In the psychological sphere the so-called law of relativity is a statement of the fact that every state of consciousness is an element in the total complex of conscious life, and is therefore necessarily influenced and determined by its relation to the other elements with which it is connected. When applied to knowledge the law of relativity emphasizes the fact that knowledge is always a process in an individual mind, and depends upon the character of the impressions which the individual receives through his senses, upon his past experience, and general intellectual characteristics, as well as upon the purpose and interest that has led him to acquire any particular information. The arguments for the relativity of all knowledge, in so far as they have been used as a basis for skepticism (q.v.), have been answered by the general line of philosophical theory which points out that, in spite of individual differences of view and opinion, science presents us with a large and increasing body of propositions that are accepted as objectively binding on all. The progress of science may be described as the sifting out of such objective truths from the conflicting mass of individual beliefs and opinions. In one sense it remains true, however, that all human knowledge is relative. For such knowledge must always be

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incomplete, and as incomplete can never express final and absolute truth.

Consult: Hamilton, 'Lectures on Metaphysics'; Mill, 'An Examination of Sir William Hamilton's Philosophy' (1865); Green, 'Prolegomena to Ethics' (1883); Bradley, 'Appearance and Reality' (1893). J. E. CREIGHTON,

Professor Philosophy, Cornell University.

Release, in law, is the name given to a common law conveyance, in which the word "release" is the operative verb. A release operates in five modes: (1) by passing an estate, as when a joint-tenant or coparcener conveys his estate to his co-joint tenant or coparcener; (2) by transferring a right, as when a disseissee (a person who has been unlawfully dispossessed) discharges his right to the disseisor; (3) by extinguishment, as the lord releasing his seigniorial rights to his tenant; (4) by enlarging a particular estate into an estate commensurate with that of the person releasing; (5) by entry and feoffment, as a disseissee releasing to one of two disseisors, which is equivalent to entry on the property and feoffment after putting an end to the disseisin.

Reliance. An American yacht. See YACHTING.

Relics, the mortal remains of departed saints; also, objects associated in memory with them, such as articles they used in life — clothes, vestments, the pectoral cross or the pastoral staff of a holy bishop, or the like: similar reminders of the life and death of Jesus Christ are also relics; and the religious veneration of all such relics when they are duly authenticated is expressly approved by the Catholic Church. The Council of Trent in Sec. xxv. of its acts and Decrees regarding invocation of saints condemns those who hold that "veneration and honor is not due to the relics of saints"; but all the Protestant churches teach that veneration of relics, or relic worship, is a sin of the nature of idolatry. In favor of the Catholic doctrine is cited the teaching of the early Fathers, who find both in the Hebrew scriptures and in the New Testament the highest sanction for the veneration of relics, for example, the incident of the coming to life again of a corpse on contact with the bones of the prophet Eliseus (Elisha: 2 Kings xiii. 21); and that recounted in Acts xix., 12 (compare v. 15), of sick persons being healed with "handkerchiefs or aprons" that had touched the living body of St. Paul: "there is a power," says St. Cyril of Jerusalem (*Catecheses* xviii.) "latent even in the bodies of the just." And the practice of the faithful in the first ages of the Church is fully consonant with this belief in the physical and spiritual efficacy of relics. The early Christians were careful to save the remains of martyrs from desecration. In the year 107 the bones of St. Ignatius, bishop of Antioch, were gathered and wrapped in fine linen, to be guarded thereafter "as a priceless treasure left to the Holy Church." In the year 167 the faithful of Smyrna exhumed the remains of their bishop, St. Polycarp, who had been burnt alive ten years before under Marcus Aurelius, and treasured them as "more precious than costly stones and more valuable than gold." When St. Cyprian, bishop of Carthage, was about to be decapitated (258 A.D.), the Christians cast towels and napkins before him that they might be soaked in his blood. After

the persecutions were over, the practice of veneration of sacred relics persisted in the Church, as is testified by the writings of St. Ambrose, St. Augustine, St. Jerome and indeed by all the Fathers of the 4th and 5th centuries. In all ages there have been abuses connected with the practice. A canon of the Fourth Council of Lateran in the year 1215 forbade relics to be sold or to be exposed outside of their cases or shrines, and prohibited the veneration of new relics till their authenticity had been approved by the pope: and these laws are confirmed in decrees of the Council of Trent.

Relief, in old English law, a fine or composition paid by the heir of a tenant, holding by knight's service or other tenure, to the lord on the death of the ancestor for the privilege of succeeding to the estate, which by strict feudal law had lapsed or fallen to the lord on the death of the tenant.

In physical geography, the undulations or surface elevations of a country.

In painting, the appearance of projection and solidity in represented objects, so as to cause them to appear precisely as they are found in nature.

Relief Sculpture. See SCULPTURE.

Religion became an object of comparative scientific study in the 19th century. Hegel (1770-1831) was the first to combine in its study the historical, scientific, and psychologic methods, though unable from lack of accurate and full data to attain valid results. F. Max Müller (1823-1901) applied the new science of philology to myths and thus identified the Dyaus Pitar of Sanskrit with the Zeus Pater of Greek, the Jupiter of Latin, and the Tiu Fader of Teutonic, which equation he declared the greatest historical discovery of the 19th century. He also urged that speech modified thought, so that myth was partly a "disease of language." This philological method was complemented by the anthropological one, founded by E. B. Tylor (1832-), who seeks the sources of myth not only in speech, but in the attempt to explain nature, in the attribution of inferred events to legendary or historical persons, and in the composition of myths to convey instruction. Furthermore he seeks light on religion from the rites and customs preserved in folk-lore.

Definitions of religion must be general enough to include its lowest and highest forms, and usually seem inadequate to religionists of the latter type. Definitions vary mostly as the animistic or naturistic element is made primary whereas properly they are coordinate. Animism is the worship primarily of deceased human souls, and secondarily of nature-powers upon the type of, or in close association with these. Naturism is the worship of nature-powers simply as man or animal, without analysis into body and soul, achieved by personification. Thus, E. B. Tylor defines religion as "belief in spiritual beings"; and Albert Réville, as "the sentiment of a bond uniting the human mind to that mysterious Mind whose domination of the world and of itself it recognizes, and to whom it delights in feeling itself united." But recognition of animism and naturism as coordinate sources of religion requires a definition of this type: Religion is the belief in and worship of supersensuous and superhuman being (beings

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or a being). The term supersensuous denotes both personified nature-powers and dead human souls, while both possess superhuman power. Man must have been the source, one way or other, of the supersensuous, of life, personality, soul, or spirit; while nature's vast operations supplied the notion of superhuman power.

This belief in and worship of supersensuous and superhuman being, that is, a god, whether it were tree-god, storm-god, or sole god, became, when defined and established, a creed and a cult, the latter being worship by offering, prayer, dance, and the like. Every religion must and does contain these two elements, for each is implied in the other; yet their ratio varies greatly in various religions. Thus, Brahmanism insists mainly upon a round of ritual both daily and seasonal, whereas Protestant Christianity cares chiefly for conformity to a confession of faith. Cult and creed differ also in their ratio of change. Cult remains unchanged for centuries and even millenniums; whereas the creed, though it may remain firmly attached to the same cult, changes slowly under the influence of men's thoughts in other spheres. Each lags behind the current belief at any given time, which must be learned from individual writers and speakers.

Creed began in the symbols and myths wrought by imagination, which reason elaborated into principles and dogmas. A natural object becomes a symbol when associated with a human experience, as water, which has variously symbolized purity in Judaism, fertility in Hinduism, and humility in Taoism. The appropriateness of the last symbolism appears in that water always seeks the lowest place. A natural process becomes a myth when so associated, as the course of the sun, which has formed the basis of such divine histories as those of Amaterasu, Vishnu, and Apollo. The religious products of the imagination are as reliable and instructive as are its literary products in metaphor and allegory. These symbols and myths deposited by naturism usually form the earliest stratum of scripture for any given religion; then come the legends deposited by animism especially in its cult of heroes; and finally sober history closes the record.

The relation between creed or belief and cult or worship is simple and direct. Belief in the gods excites man to a sense of dependence upon them in that he hopes for good and fears evil from them. But his sense of freedom permits him to secure the good and avert the evil by means of worship. This was naively rendered by offering to the gods whatever was useful to man, such as food—both animal and vegetable, clothing, weapons, and ornaments. The natural accompaniments of these gifts were prayer and praise, which stated the grounds or conditions upon which the gifts were made. "Give us harvest that we may give you cake." Music and dancing were performed on the same principle; and, when lively, expressed joy, when slow, grief.

Religion as defined above is a cultural, that is, an activity proper and peculiar to man, and as such takes equal rank with the other cultural, industry, knowledge, art—whether visual or audible—and morality. Religion is as proper to man as any of these, for it springs from his normal impulses of hope and fear in presence of the world about him, whether nature or

human nature; and is as peculiar to him as any other cultural, for no other mundane creature exercises it. Religion, therefore, rests upon the same firm basis as the other cultural, namely, the undeniable and unalterable constitution of men and of nature, in both of which the Infinite is ever present, though in ever varying degree. Religion shares with other cultural also the vicissitudes and final high destiny of development. It began in vague and crude notions and practices; very generally progressed; and then either suffered arrest and sometimes even regress, or under better conditions and in spite of survival and revival of outgrown traits, attained its present high, though not yet perfected and therefore final stage. The causes of this development also are not different from those for other cultural, and may be formulated as follows:

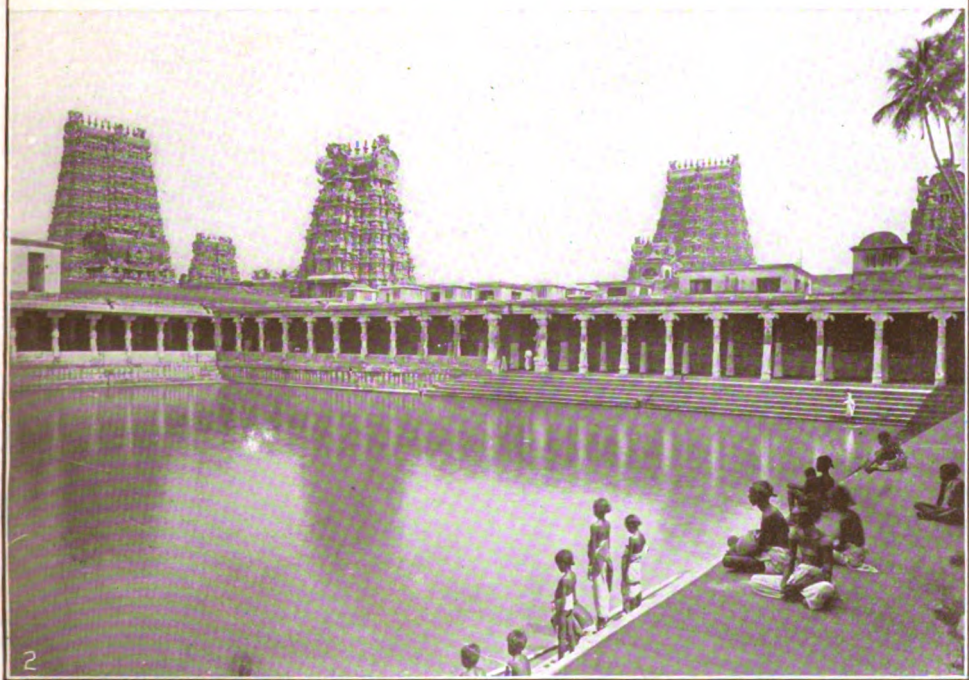
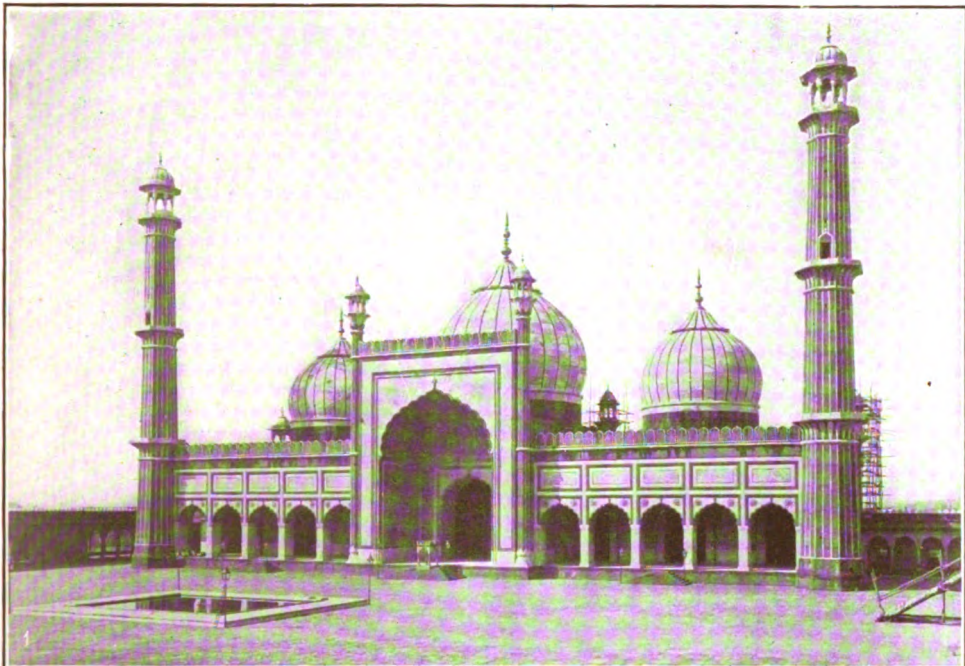
(1) Direct Causation: The predisposing cause of the development of a cultural is the potentiality (constitutive norm or principle) of mankind, and more particularly of a single race, people, or man. This is heredity with variation. The exciting cause of the same is experienced nature and man. This is environment. From their community in these two causes there arises an analogy between all cultural processes.

(2) Indirect Causation: Each cultural stands in solidarity with each other, and therefore promotes its development. This is interaction. Whenever two or more human groups of various heredities and environments meet, their mutual comparison, modification, and complementation promote development. This is intercourse.

(3) Traits: Besides these laws of external causation, there are others of inner change. These are continuity, synthesis, differentiation with unification, and classification.

That religion is thus hereditary with man, or, to speak more simply, that man has a religious nature, appears certain from the fact that no tribe of men has been found without religion, as is now granted by ethnologists. As God did not make man and leave Aristotle to make him rational, so neither did he leave Moses (or Kongtze or Manu, or Zarathustra) to make him religious. After all other causes of progress have been allowed due weight, there is a residuum of effect which implies this inner growth of man as its cause. But religious nature would have remained mere potentiality forever, had not an environment of nature and fellow-man excited it to functioning. This accords with Leibnitz's maxim: "There is nothing in mind that was not previously in sense, except the mind itself." Of this environment, nature proved occasion for nature-worship, and man for ancestor-worship. Minor or major deities have been drawn from every kingdom of nature. Thus, the phallos and kteis were seen in water-worn stones, while trees yielded the sakaki, the pipal, the oak, the peach, the birch, and the mistletoe. Water, in the shape of wells, springs, rivers, and seas has everywhere received worship, as also has fire. The greatest gods have taken their source from sun and moon, wind and storm, heaven and earth, the last named always being a sexual pair. Divine honors have been rendered the serpent, fox, monkey, ox, jackal, and bear among animals. All these ob-

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1. Mosque at Delhi, India.

2. Pool in Shaivite Temple, Madurai, India.

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jects could do some things beyond human power, and were credited with personality in so doing. Thus they became superhuman, supersensuous beings, that is, gods. To them man turned in his various needs, as the sources of his food, as the causes of events, as the vast or infinite beyond all finite, as the incomparably beautiful, or as the guardians of right. The other taproot of religion was man-worship, whether of ancestors, heroes, or even living men. World-wide data indicate the following source for ancestor-worship. Primitive man explained his supposed temporary absence from the body in dreams by the action of a separable self, double, shade, image, or breath, as it was variously conceived. He could then explain death as the permanent absence of such spirit, and could present offerings, in return for which the dead person (supersensuous), now become also superhuman, afforded help and protection. If the deceased had been famous in war, invention, learning, or holiness, these offerings became public concern and thus hero-worship, as with Jimmu Tenno and Rama. Such a hero is sometimes worshipped while yet alive, as were Cæsar, Mikado, and Chaitanya. Besides the above objects of worship or creed, also the methods of worship or cult took their source from nature and man. Thus, the festivals at midsummer (still important in the Orient) and midwinter (New Year) were determined by the sun's solstices, as were those at spring and autumn by its equinoxes; while hours of worship were sunrise, noon, and sunset. The fourteenth and seventh days were successive divisions of the moon's 28-day period, and sacred alike in Judaism and Buddhism. The birth, puberty, and death of the individual called for ritual, while the hero added to these the dates of his victory, enlightenment, temptation, or the like. Nature gave the earliest sacred places, around tree, well, etc., while offerings to earth-gods were buried, and those to heaven-gods placed on hill-tops or burned to ascend in flame. The first sacrificer was father or chieftain, and the first sacrifices food, drink, clothing, weapons, etc. The remains of food or drink were consumed by votaries in what thus became a peace offering or communion. The accompanying prayer, music, or dancing were equally based on human models.

It was combined heredity and environment that imparted distinctive characteristics to the various religions. These are the emphasis on the future life by the Egyptians; the power and inscrutability of the divine among the Babylonians; loftiness and, later, ethical holiness in Jehovah among the Israelites; the duty of co-operation with Ahura Mazda to improve the world among the Persians; ascetic neglect of the world among the Hindus; insistence on the moral providence of Tien by the Chinese; visualization of the divine in beautiful forms and ennoblement of it by philosophic reflection among the Greeks; and, finally, the control of religion by state needs and hierarchical orders among the Romans. Even entire races have such characteristics. Thus, the Semites conceived their gods to be remote, austere, and self-centred, whereas the Indo-Celts made theirs immanent, genial, and related to man. The Mongolians approximated the Semites. The religious æstheticism that arose in beautiful Greece and the

pessimism in sultry India show influence from environment, but the unrivaled philosophic attainments of these kindred Indo-Celtic peoples must be attributed to heredity.

First among the indirect causes of religious progress is interaction with other cultural. Thus, in industry, writing made scriptures possible. In knowledge, philosophy guided the great reforms of the 6th century B.C., made by Lao-tze, Kongtze, Gautama, Buddha, and Xenophanes. The Renaissance was pre-condition to the Reformation; and ever since science has corrected and interpreted religion, doing so preeminently as the science of religion or hierology, of which this article is an outline. Moreover, there is a religion of science, inasmuch as what science reveals, religion construes as the will of God. Fine art mightily aided religion when it humanized the vague and crude nature-gods by means of the idols and pictures made to represent them, the temples to house them, and the music, dance, and drama to entertain them. What we know as Greek statues were mostly Greek idols and reflected their consummate beauty back upon their divine originals. Progressing literature and music have likewise given ever nobler expression to religion, and have thus advanced religion itself. Ideals of morality and law have improved both the creed and cult of religion. Early gods sometimes reflected the current cruelty or lust; and, as morality improved, were either corrected into nobler types as was done with Zeus, or vindicated by apology as with Krishna. Other gods with better mythical implications, like Tien, Agni, Jahve, and Apollo, were gradually transformed from the nature to the moral type as their worshippers improved. In cult it was morality that motived the change from ceremonial to moral purity as the condition of approach to deity. Politics also influenced religion, because victory was attributed to the favor of the god, as when Jupiter became Optimus and Maximus over his rivals among the Latin tribes, and when the national experience of Judah led it from mono-latry to monotheism.

Industry, knowledge, art, and conduct still interact with religion, and, in combination with its own inherent growth, will decide the fate of extant faiths. Thus, all polytheisms, such as Shintoism and Hinduism, are doomed by the unitary conception of the world, which is held by science; and Mohammedanism must end or mend before sculpture and painting, which it now prohibits, as well as before morality, which it now violates by polygamy. This interplay of forces exemplifies the late laureate's insight that "God fulfils himself in many ways, lest one good custom should corrupt the world."

The inner growth of religion, further influenced by interaction with the other cultural as above explained, has developed an ever nobler conception of God in terms of personality, which can differ from the human only in degree of perfection, amounting, however, in the case of the monotheistic God to infinity. God is now apprehended as Infinite Person or Absolute Spirit, and worshipped because held to possess idealized human worth in each and every sphere of culture. No man has seen this God at any time. God was revealed by himself and discovered by man through the mediation of nature and humanity aided by the other cultural. This

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process, however, affords no ground for reducing the notion of God to any of these terms; as when B. Spinoza, the pantheist, or D. F. Strauss, the materialist, would identify him with nature; or as when Auguste Comte, the positivist, would identify him with humanity. Similarly religion is not devotion to science, as J. R. Seeley claimed; nor a "creation of the spirit" by the same imagination that produces art, as Albert Lange held; nor, finally, is it "ethics heightened, enkindled, lit up by feeling," as Matthew Arnold taught. In particular Schleiermacher protested against this last misconception of God as a travesty of him into a universal policeman. God's function is not limited to being a judge, but includes every noble activity known to man. Religion is as unique as are the other cultural, none is false and none reducible to the other.

The other indirect cause of religious progress is intercourse among various human groups such as tribes, nations, or races. Comparison has afforded a superior religion increased confidence in itself, as when Aryans entered India. Modification of a religion has resulted from its introduction among other people, as when Buddhism overspread Asia. And complementation of one religion has been supplied by another, as when Confucianism, Taoism, and Buddhism made a religious compound in China.

The first trait or inner law of development is continuity. Nature makes no leaps in religion or elsewhere, but makes progress one step at a time. This law has made it possible to trace backward many a creed or cult through strange metamorphoses to primitive notion or rite. The law is so inevitable that even so-called founders of religion could effect their purpose only by reform of what they found at hand.

Synthesis was first observed by Hegel. Whenever a thesis exceeds moderation, it excites the opposition of some antithesis, with which it may finally coalesce into a synthesis of some larger fact that includes both. So, asceticism always tends to license, and *vice versa*, while both are sublated or taken up into normality. This was the consummate Greek insight, *mēden agan*, nothing too much. The prime example of synthesis in religion is modality, which results from excess of either one of the three mental functions in relation to the other two. Excess of volition produces the modes of moralism, legalism, or sacerdotalism; excess of intellection produces the mode of rationalism; and excess of emotion produces the mode of evangelicism, pietism, or mysticism. Ethnic religions begin with legalism as thesis, react to rationalism, and synthesize in mysticism. When a universal religion begins at synthesis as did Christianity, or at antithesis as did Buddhism, it passes to the other modes in due course. The perfection of stable balance can be only approximately realized either by individual or by people. All extant religions contain all three modes, and each mode should tolerate the other.

Differentiation with unification of quality also marks religious progress. The stone implements of various savage peoples differ little, and so do their religions. But civilized peoples show wide differences in religions. These are greatest where the peoples have moved apart,

as did the Indo-Celtic nations, some eastward into Persia and India, others westward into Europe; since this isolation involved differences in all the causes of development direct or indirect. A less differentiation arose from the same cause without isolation, as in the case of the numerous sects alike in Shintoism, Hinduism, Buddhism, Islamism, and Christianity. Later on, these divisions draw together into associations, unions, and the like, to secure greater efficiency.

The various stages of development afford the best basis for the classification of religions, and hierologists differ only as to the fittest marks of these stages. Probably the best classification is into tribal, national, and universal. The national or moral religions extant are Shintoism, Confucianism, Taoism, Hinduism, Jainism, Parseism, and Judaism; while the universal or redemptive religions are Islamism, Buddhism, and Christianity. But every like is not the same, and wide differences exist within the bounds of either class. Thus, among the universal religions, Islamism is sensuous, Buddhism is at least negatively ascetic, but Christianity recognizes both normal humanity and ideal aspirations. Again, Islamism became universal only by force; Buddhism holds exclusive sway over only Ceylon, Burma, Siam, and Nepal, all decadent nations; whereas Christianity is confessed by the great world-powers. The principles of Christianity are the highest and its forces consequently the greatest attainable, but both await correct adjustment to society by advancing science, notably sociology.

Finally, no hierologist supposes that religion will ever perish, for it makes man at home in the world and thereby supplies his chief mental need. The Lord's Prayer expresses this central truth with such incomparable purity and simplicity that it now constitutes at once the best creed and the best cult, and seems assured of universal acceptance.

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Religion, Established, or State Religion, that form of religious belief and worship which is recognized by the government or constitution of a country as national, and which enjoys certain privileges and is supported by the public treasury. The idea of complete separation of civil government and religious affairs is peculiar to modern times. In the ages before Christianity the administration of religious affairs was a function of the state and the priesthoods were orders in the state. After the triumph of Christianity the relations between church and state in the Roman empire were intimate, and the civil power freely intervened in the government of the church: the prelates of the church, too, were vested with extraordinary powers by the state. Throughout the Middle Ages the civil power was everywhere in the last resort the church's armed right hand for the enforcement of uni-

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1. Japanese Temple, Kyoto. 2. A shrine of Jizo, the patron Deity of women and children.

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formity in religion. For a long time after the Reformation the uniformity of religious belief and ceremonial was held to be indispensable: in the present age, though in many countries state churches exist, controlled by the public authority and supported from the public purse, uniformity is no longer enforced by civil penalties and the subject is permitted to reject the state religion, to embrace another religion, or to ignore religion, though usually dissidents from the religion of the state suffer certain civil disabilities. It is urged in favor of the national recognition of a form of religion, that if the majority of a nation are prevented from making this public recognition of it, as a matter of primary importance to the state's welfare, then they are subjected to coercion by the minority; and if an established church uses no sort of coercion, its being supported by the state in the face of a protesting minority is no greater violation of equal rights than would be its disestablishment at the behest of the same minority.

Religions, Congress of. See CONGRESS OF RELIGIONS.

Religious Art. Two large subjects are comprised in the expression, Religious Art: Religion and Art. The union of the two finds a development in practically all races, and a not too delayed one; for aspiration and sense of beauty are almost instinctive. The worshipful tendency in man which submits him to some more than human power as an object to be adored, served and propitiated, ranges from fetishism through idolatry, ancestor worship, polytheism, or the divinization of man, and abstract dualism of a controlling good and bad spirit, up to the Christian cult of one pure Supreme Being. The Art developed under Christianity, though generically included under Religious Art, and, like its other forms, exhibiting phases and modifications due to race, environment, influence or period, is apart from, and superior to them by reason of the higher ideals which dominate it. There is, moreover, no art which Christianity has not employed with distinction in its worship, and in the variety and profusion of such productions of a religious character, not a few may be regarded as exemplars in their respective fields, especially in architecture and painting. For this reason Christian Art demands special consideration, and will not be treated under the present head. See PAINTING; POST-RENAISSANCE PAINTING; RENAISSANCE PAINTING; ROMAN CATACOMBS.

"The first impulse to art is much the same, whenever or wherever it is felt in a race," says Lübke in his 'History of Art.' Naturally, these initial movements are of the most primitive character. Among relics of the Cave Dwellers are bowls with animals scratched or carved on them. Animal-worship is a rudimentary stage of Religion. In Egypt, coupled with ancestor-worship, it long retained a hold. The art of Egypt rose chiefly out of the latter. Some of the earliest structural efforts of Man have suggestion of Religion in them: for instance, the dolmens and cromlechs; the former, consisting of a stone placed transversally upon perpendicular ones, suggests an altar even more than a tomb: the latter, of a circle, or circles of stones surrounding a central monument. Architecture, sculpture, painting, and music are the

arts which have been most drawn on, and with the most important æsthetic results, for religion. Music, though adding notably to the dignity and exaltation of public religious services by its subjugating emotional appeal, leaves no impressive signs of its effectiveness, like the other arts, and needs no further mention — the more so, as it found nothing like due development except in the Christian Religion.

The oldest monuments, those of Egypt, are architectural, and sculpture and painting were, as a rule, subsidiary to this art. Painting in its full accomplishment is the latest of those arts. Among the older races, the Egyptians rank more prominently for the blending of Art and Religion, both as to antiquity, development and monumental survival, while the Hellenic Greeks were the most conspicuous and exquisite exponents of Religious Art of all the pagan races. Sculpture became for the first time an ideal art in Greece. Sculpture in Assyria, as well as painting, was mainly for the glorification of the monarchs. In Egypt, while religious and monumental, it was singularly conventional, its stereotyped figures showing scarcely any advance for centuries. This was undoubtedly due to sacerdotal restraint. Greece, which had borrowed much in her art from both these countries, shook off the narrow restrictions which fettered it in them, and forged ahead into an exquisite independent style, distinctively her own. The highest expression of it was Religion: for the temples of the gods, and statues of the gods and goddesses themselves, were the worthiest objects of artistic emprise. True, the divinities that the Greek chisel drew from the marble were but ideal forms of human beauty invested with suggestion of moral attributes of the loftiest natural conception.

This Art blended with Religion reached its acme in Greece, in the 5th century before Christ, the age of Pericles. The Persian wars had swept away Oriental despotism, and in literature and art the Golden Age was at hand. Pericles encouraged genius of every kind. "The Drama and Sculpture both elevated the National Religion," says Rio, in his 'L'Art Chretien.' The School of Phidias selected as some of its most inspired themes the divinities of the people for whom they worked. Pallas Athena, sprung from the brain of Jove, Goddess of Intellect, as tutelary divinity of Athens, the principal city of Greece, was naturally one of the most compelling inspirations of the sculptor's art. Nine statues of her were carved by Phidias, the master creator of that splendid art period. Sophocles, "great and pure genius," took devotedness, ennobled by the accomplishment of a great duty, as theme of predilection for his dramas. The exalted scope of the dramatists inspired sculptors and architects with their dignified and glowing conceptions. The severe but exquisite beauty of the chaste Athena was the sculptural embodiment of the Art Spirit of that glorious epoch, the ideal impersonation of contained strength and wisdom; just as the chryselephantine statue of Zeus for the Temple of Olympia, likewise the work of Phidias, was crystallization of the national idea of the Supreme God, a divinely human type of masculine perfection.

Venus, the goddess of a decadent age, was unable to inspire the people that worshipped her

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with the virtues of which they stood in need; beautiful in the sensuous grace of art, but with the vivification of religious feeling evanescent. Rio, *a propos* of the Athena of Phidias, propounds a fascinating query: "Was she not the formula of a dogma lost long ago for the people but glanced at and put together by Platonic philosophy? The different traditions relative to her cult resemble the feeble rays of a primitive revelation."⁹

The Amazon of Greek art was a transition from Minerva to Venus, and the best exponent of this transition in dramatic poetry was Euripides, less than Sophocles or Æschylus in the association of religion and art, but who exploited more than he is commonly credited with doing the religious side of national tradition and made war against mythological absurdities. There were fifty Amazons sculptured, life-size, in the porch of the Temple of Diana, in Ephesus: guardians of her whose favorite virtue was chastity.

No people ever reveled more in the joy of living than the Greeks, and the wine that inebriated them was Beauty and Religion. But if the gods were the theoretical object of their worship, the passion for Beauty, which led for the first time to the evolution of the Ideal in Art was probably a more constraining cult. Deities peopled his land to a Greek. In gratitude for the exhilaration which was aroused within him as the physical world poured through the portals of his vision, he returned thanks to the gods who ruled the earth, the sea, the sky, by erecting to them temples in which material, mass, line, and proportion blended into a dream of structural beauty, and by bodying forth in marble the human form with every physical and ethical grace possible to Man, and giving to them names of the gods. The aroma of their superhuman beauty has survived to this day. The Renaissance caught something of the Greek spirit, but not its exuberant vitality or creative glow. There is a higher religious beauty to the best paintings of the Christian artist to one who brings religious eyes to see them with, but, barring the charm of color and the tone and depth of its pigments, a religious Greek artist might look upon the Sistine Madonna with more curiosity than reverence, while even ascetic eyes of the period of the Renaissance must needs have felt a touch of exaltation before the Pallas Athena.

Egypt was antipodal to Greece in its religious art. The mythology of the region of the Nile was a blend centuries old. The sombre shade of death was its characteristic, as life was that of the Greeks. The Egyptian temple was massive, heavy, and provocative of chastened feeling. Through the centuries, the type persisted. The Greek temple appealed more to the spectator looking at it from without than to him who beheld its interior, and the severe Doric style was succeeded by the greater ornateness of the Ionic and the Corinthian. The Egyptian temple, like the Indian, consisted of a cluster of different parts enclosing a small sacred shrine in which reposed the god. A row of Sphinxes or ram-headed Colossi, all alike, and in an attitude of repose which expressed reserve and stolid dignity, but little grace, led up to the entrance: two similar façades convergent toward

the top with a narrow gate between. This entrance led to an open court with porticoes. Beyond were other halls, leading to the small sanctuary, or cell, only a few feet in dimension, in whose gloom reposed the god. There were no windows in the temples and the great wall spaces, as well as the columns and cornice, were covered with hieroglyphic inscription, figures of gods and of rulers, painted in bright, primary colors. There is no high ideal feeling in symbolic religious portrayal. The gods are distinguished from humans in the Egyptian paintings by different heads of animals and by the dress they wore. These animals were hieroglyphic signs of their names. Thus Thoth had the head of an ibis; Anubis, that of a dog; Hathor, that of a cow; the goddess of Neith, that of a lioness, and so on. The dress of the gods resembled the short ancient undress of women, and they had a special beard, longer by two inches than that of mortals, and turned up at the end. They are not living things like the Greek gods, but merely important symbols. The ancient mythology of Egypt supposed gods, then demi-gods, then the mysterious Manes. Ptah was the father of the gods, and his four sons, Ra, Shu, Seb and Osiris, represented respectively fire, air, earth, and water. Isis was the sister and wife of Osiris, and Horus was their son. Anubis was also son of Osiris. Set, the evil god, tried to destroy Osiris, who was protected by Horus. A symbol of Horus, a great sun-disk with widespread colored wings, was sculptured over the doors of the temples to drive away unclean spirits.

Another note of Egyptian art is the Uræus, a venomous Egyptian serpent which always encircled the diadem of the Pharaohs, as a symbol of royal power, because of its swift effects for life or death. The sun-god, Ra, conquered the Uræus for his diadem. Snakes were kept in the temples. Plutarch says the snake was revered as something sacred because of its power of gliding along without the aid of any limbs, like the stars.

Different cities were devoted to this or that special god. Memphis was faithful to Ptah. Abydos to Osiris, Denderah to the goddess Hathor. From the oldest records, the pyramid texts, the development of religion was complete and remained practically the same thereafter, though there were myths and much irreconcilable confusion. The sun-god, Ra, was common to all Egypt. There was a close relation between kings and gods and priests. The kings conciliated the gods by building and maintaining temples. King Tehuti-mes III. (1533 B.C.) built the temple to Osiris at Abydos. On an obelisk is an inscription "King Tehuti-mes has caused this monument to be erected in remembrance of his father, the god Herem-Khu (that is, Helios, the Sun)."¹⁰ Khamnes, son of Rameses II., was high priest of Ptah at Memphis, and did much to restore the worship of Apis, the living type of Ptah-Sakari. Osiris at intervals became incarnate in a bull with exotic markings. The Serapeum was the tomb of the bulls thus glorified by the indwelling of the god, who if they lived twenty years, were ceremoniously slain, and their exuviae preserved and revered.

Painting with the Egyptians was only a

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kind of picture-writing, although interesting as decoration. Even subjects that seem secular and domestic had affiliation with religion which they would lack in another race. Agriculture was to be practised, for instance, in Elysian fields after death. The colors employed were black, green, red, yellow, blue, brown, and white. The colors employed for the pictured gods were vivid red, green, yellow, or blue. Religious, historical and domestic themes were treated with considerable uniformity. The worship of the dead, rites of burial, weighing the departed soul in scales, transportation of mummies in funeral barges, the king offering gifts to the god, are some of the religious subjects. A painted chronicle, that is the note of Egyptian Art. Leipsius calls the art of Egypt "a child: a strictly, heedfully, narrowly brought-up child." The child never grew up. A network of sacerdotal prescription enmeshed all the monuments of man's life and paralyzed individuality and originality in Art. Painting was not merely on flat surfaces. The Egyptians colored their bas-reliefs, and the designs incised deeply in the stone, which are called *bas-reliefs en creux*, or hollowed reliefs. The lotos, or water-lily of the Nile, was anciently used in religious rites and figured in art decoration. It was carried from Egypt to Assyria and has place with the fir-cones and honeysuckles, introduced in later sculpture in Nineveh. In India, it serves as a Buddhist symbol, the petals in the wheel-like form of the flower typifying perpetual cycles of existence.

The religious art of Egypt is inferior to that of Greece not only because of its being symbolic, restricted, sombre and heavy, but because the idea of divinity with the Egyptians, in Art, at least, was not anthropomorphic. Their gods had animal heads. A god, therefore, was non-human and monstrous in this respect, just as the hundred-armed god of the Buddhists is in Indian Art. Symbolism does not lend itself to idealism: hence its lack of development. The art of Greece and Egypt, however, affords the two most significant examples of religious art among the nations of antiquity. Roman art, borrowed from the Greek, and although it created no ideal forms in Art which were original, it produced sculpture only second to Grecian, either the work of Greek artists after the subjugation of Greece by the Romans, or imitation of Greek ideals by Roman sculptors. Sculpture as an accessory to architecture and in portraiture was carried to much perfection under the Roman emperors who succeeded Augustus. In the Arch of Titus, erected as a memorial of the conquest of Jerusalem, there was represented a procession carrying away the spoils of the Temple, including the Ark, and the seven-branched candlestick. Although this is not religious art, for it only commemorates an Imperial victory, yet is mentioned as interesting that the two art products of the Jews which were most sacred should thus be exhibited as a note of the triumph expressed in a monument to the glory of a pagan emperor. Cameo-cutting and bas-reliefs on sarcophagi were artistic productions finely executed, in the decline of the Roman Empire, when the arts had also declined.

In architecture, the Romans copied and

modified from Etruscan buildings in their earlier work and from the Greeks in their later. They brought the arch and the vaulted roof to great perfection. The Corinthian order, which they largely affected, was modified, in their efforts to lend it fulness and strength, into the Composite or Roman order. The Pantheon of Rome, the finest monument of Roman architecture, was built by Agrippa (13 A.D.). It was one of the grandest buildings of the ancient world. The Tomb of Hadrian, the Castle of San Angelo to-day, surmounted by an angel, surpassed any sepulchral monument of its time.

The religious art of the other nations of antiquity was inferior to the manifestations of it already recorded. There is no sculpture or painting of an early date in Chaldaea or Babylon, though Chaldaean traditions have been the foundation of the arts of western Asia. They worshipped heavenly bodies and the temples were also observatories. Phœnician Art (q.v.) is a mixture of Assyrian and Egyptian. In Assyrian art there are winged figures of bulls with bearded human heads. There are no traces of Median art. The religion of the Persians was based on a dualism of essentially moral character. The Kingdom of Light or Ormuzd, Goodness, is opposed to the Kingdom of Ahriman or Darkness. In Persian art (q.v.), the King is represented worshipping Ormuzd, the God of Light, with Ferouher, or Wisdom, over his head, as a man with the wings and tail of a bird. The stone altars on the mountain tops are the chief monuments of Persian religious art, though it was really the followers of Zoroaster who venerated fire as a symbol of the Deity, Ormuzd.

Religious art in India appears to have begun with Asoka, who adopted Buddhism, and was the Buddhist Constantine. Buddhist architecture is the oldest style, and it embraces monasteries hewn out of the solid rock; high memorial mounds, or Topes; Pagodas, detached buildings surrounded by a series of walls, and Mosques, built by Mohammedan conquerors who brought their own style with them and combined with it native ornamentation. In the very first period Indian art attained a distinctive style, which was employed in religious monuments. The Brahminical sects adopted it and later it was transformed by profane ornamentation. The founder of Buddhism, Gotama Sakyasinha, reformed the old Hindu pantheism, Brahmanism. He is represented seated on the sacred lotos which is supported by the avatar of Sakya, the lion. There is some similarity between the Buddhist temples and those of Christianity. Rows of pillars separate the nave from the aisles, and a small dagoba, or shrine, rises at the end of the cave (the temples were originally monasteries cut from the rock) in which is the seated image of Buddha. This is where the altar would be in a Christian church. The Mosques are the most remarkable of all the Indian buildings.

Mohammedan religious art has peculiar restrictions and yet quite a distinct character. "Images," it is said in the Koran, "are things to be held in abhorrence." Tradition also ascribes to Mohammed's oral utterances this one: "Woe unto him who paints the likeness

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of a living thing: on the Day of Judgment those whom he has depicted will rise up out of the grave and ask him for their souls. Then, verily, unable to make the work of his hands live, will he be consumed in everlasting flames." With figures thus barred, the art of the East is mainly decorative. All races alike begin with surface decoration, whether wall painting, glass painting or tapestry. But the evolution of Western art led to the treatment of a flat surface in a way to remove the sense of flatness. Color is only a means in painting that has reached a developed state, but it remains an end in itself for the East which regards it as an ornament, and the Oriental feels no need of anything in art that transcends ornament. Arab predilection for this, and the exclusion of animal forms, lead to designs in which geometrical figures, vegetable forms, and letters or sentences from the Koran are the elements. With sculpture banned as to its principal object, and only flat ornament of conventional design, there is not much to be said for Mohammedan religious art in sculpture and painting. The same color effects are found in secular and in sacred buildings. In the beginning, Mohammedans found that Christian churches served well enough for their religious rites. The earliest mosques were built by Christian architects. Almost every new style of architecture is the result of the requirements of a new religion. Gradually, therefore, the Arabesque style of decoration asserted itself, and the horseshoe arch originated in their architecture. This novelty became and has continued a distinctive feature of Mohammedan Architecture.

In a mosque, a portico surrounds a fountain for ablutions: in the southeast part is a pulpit, and in the direction in which Mecca lies is a sacred niche (Mihrab) toward which the faithful must look when they pray. Opposite the pulpit was a desk for the Koran. The simplicity of the earlier mosques gave way to an infinite variety of arched courts, gateways, domes and minarets, the dome constituting the leading feature. The Moors introduced a ceiling known as the *stalactite*, which became as distinctive of their architecture as the horseshoe arch. The minarets are tall towers of several stories from which the muezzin calls the faithful to prayer. Sometimes the outside of a mosque is without ornament: but the flat surfaces of the interior are always profusely decorated in the richest colors.

Arabian art first acquired a distinctive character and a settled style in Egypt, but Saracenic Art touched its highest beauty in Spain. Everywhere lavish color and profuse ornamentation remain its features. When the Mohammedans conquered Constantinople, 1483 A.D., they took Santa Sophia as their model and thereafter their buildings are more or less perfect copies of that work of Justinian. The Mosque of Suleiman II., at Adrianople, is an exact copy in plan and form, though differing in detail. The Mohammedan's chief thought was religion, and he made all the arts subservient to it. The most beautiful Persian and Turkish rugs are prayer-rugs. The Smyrna prayer-rugs have a plain centre, green, blue, yellow, ivory, or red, with the prayer point supported by two columns, from which hangs a lamp. Sometimes, the pillars are omitted and there is a modification of the

Tree of Life. Bokhara prayer-rugs have the centre field divided into four sections by a large cross. At the appointed hour for prayer, the devout Mohammedan spreads his prayer-rug with the Mihrab (niche) toward Mecca, and prostrates himself, his head resting on the rug at the point, his hands outstretched. There are small prayer-rugs for the children, and occasionally rugs have two or three niches, as if intended for a family rug. The most exquisite rugs are sent to Mecca as propitiatory offerings. The mosque at Meshed is famous for its gorgeous carpets, whose soft, glowing colors harmonize exquisitely with the iridescent effects of the tiled walls.

A reflection made by A. F. Rio, in the introduction to his '*l'Art Chretien*,' is interesting as a theory to account for the note, so to speak, of religious beliefs of the various peoples, which flowed more or less into productions of their art. It may serve as conclusion to this article. He says: "There is a point of view which dominates all the others in the respective doctrines of the peoples of antiquity: that, namely, which shows us the special vocation of each race in the religious dogma which has determined more particularly its intellectual and moral development, and which has been assigned it as its proper inheritance from the debris of primitive beliefs, after the catastrophe which had as a consequence the dispersion of the human race."

"The share that fell to Indians (East) was the dogma of the divine incarnation, on which they have constructed their gigantic epics: that to the Phœnicians, the mysterious dogma of an original prevarication which demanded incessant expiation through immolation of human victims: that to the Persians, the constant antagonism between the two Principles which dispute for the empire of the World and that of Conscience: that to the Egyptians, the dogma of immortality in view of the recompenses and chastisements after death: that to the Greeks, the double degradation of man through his fall, that of the body and of the soul; as if this privileged race had heard distinctly through the rumbling of the ages only these words of Genesis: 'God created man after His own image.' This race gave itself instinctively the mission of rehabilitating the human creature as well in his faculties as in his form: in a word to introduce into the world the notion of the Ideal. Another even more privileged people, the Jews, had been appointed with view to their honor of the True, as the Greeks were to the honor of the Beautiful."

Sir W. M. Conway finds the art in which different peoples have excelled due to the ideal they strive to express: that of persistence, among the Egyptians resulting in architecture; of reserve, among the Greeks, in perfect sculpture; the Mediæval ideal producing chivalry, feudalism and Gothic architecture: the Renaissance ideal, study of antiquity, revival of learning, tendency toward despotism in government, and the great Italian and German schools of painting.

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Religious Education. Religious education is a phrase (recently become technical) to

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denote a particular type of education which makes full use of the religious and moral forces in human development. The rise of this new educational ideal is due to a better understanding of the processes of mental and spiritual growth, to better methods in child training, and to better knowledge of the Bible as the primary means of religious and moral instruction. Historical and psychological study have brought in a new era of thought, for they teach us to look at the past not as a flat picture, but as one having shading and perspective. The story of the past is a story of development; the race has slowly grown, stage by stage, from the most primitive condition to the present relatively high plane of civilization. Man has progressed physically, intellectually, morally and spiritually through the ages.

In this development religion and morality have been chief factors. Progress has been largely accomplished under the guidance and stimulus of the religious and moral instincts native to mankind. There has been an increasing perception of truth, right and goodness, an ever higher idea of God has been gained, and it has become recognized that the Bible is a record of this spiritual experience and growth of men.

Religion is no longer conceived as a mystical and unrelated element in life, coming and going without any known order, an intermittent activity in his world of an absentee God; instead, religion is that essential element or attribute of finite personality which unites it with the infinite, and promotes the development of the highest humanity. Also the Bible appears, not as an epitome of all knowledge, cast down from heaven complete, to make human experience and thought unnecessary, but as a helpful account of the religious experiences and ideas of the past as men have progressed under God's guidance and blessing toward the divine ideal.

One great discovery of modern education is that, since the individual is an organic unit, the true education for him must be an organic unity. The whole man is the subject of education; he does not develop piecemeal, first on one side and then on the other; he does not grow by the attaching of one kind of knowledge to him on week-days and another kind on Sunday. He develops by an innate process. The chief object of education is not to supply information, but to develop character and social efficiency. The distinction between instruction and education is clarifying: instruction is the act of imparting information, education is the process that includes all means of development. Education includes instruction as one of its features, but it is a world-movement which makes for the realization of world-ends. The clearest analogy for education is drawn from plant life: the acorn grows into the oak because of its own inherent vitality and destination; it is assisted in this growth by the soil, the rain and the sunshine. Similarly the child grows into the man because it has the potency and destiny of manhood; it is assisted in this growth by an environment which if ideal contains all those elements that are most helpful to physical, intellectual, moral and spiritual development.

The business of religious education is to create this ideal environment for every child, so that his growing personality may lack none of those things required for perfect self-realization. Religion cannot be thrust into the child by instruction in the dogmas, the ritual, or the history of ecclesiastical institutions; religion is rather a force within the child which makes for his highest development and well-being. Religious education must therefore operate to give this inner force the best possible opportunity to accomplish its results. For this reason the best education is religious education, that is, an education which recognizes the function of religion in human development and makes due provision for its contribution. All education is essentially religious, for religion seeks the highest development of men individually and socially, and all that contributes to this end is religious.

Here also morality finds its close connection with religion. Our conduct toward ourselves and toward others springs from our view of life, our sense of duty, our conception of goodness. These belong to human personality; they arise within one. They constitute the religious elements of mankind; they are factors of our development. Religion therefore finds one of its chief ends and expressions in conduct. Not all ethical feeling and instruction rest consciously or confessedly on this religious foundation; but if religion is what it is here supposed to be, religion does in fact determine humanity, for the principles of conduct are those which grow out of one's world-view.

With regard to the material which may be used for religious education, it is now clearly seen that the child is not a miniature man, capable in a degree proportionate to his size of all the sensations, emotions and ideas of grown people. Children do not have and cannot have those theological ideas, spiritual upheavals, mental struggles and moral experiences which belong to adolescence and maturity. Therefore literature or material of any kind which describes or is designed to arouse or to inculcate these phenomena of adolescent and adult life is not adapted to children, and should not be used in teaching them. This means, for instance, that the Bible, which largely records adult ideas and describes adult experiences, must be wisely used with children. Only such material as is appropriate to the several stages of human growth should be employed in the religious training provided for these stages. And other material from outside the Bible which can be made helpful to children in their development should also be used at suitable times and in suitable ways. It is clear that the Bible, rightly interpreted and rightly used, will be the most valuable literature for religious education. This is just because the Bible gives a religious history of that nation in the past which achieved the noblest religious ideas and the highest religious experiences. But it will also be found that there has been much true religious thought and experience, pre-Christian, non-Christian and Christian, which has found record in other literature than the Bible; these writings, too, whether past or present, will be used as they are qualified for promoting religious education.

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In addition, there is the religious thought and experience of the present time, written and unwritten. This means of religious nurture is largely ignored. The great religious events, activities, ideas and experiences of the past are made much of, while the great religious events, activities, ideas and experiences of the present are regarded as without official approval, or too commonplace, or too progressive to be treated as material for religious education. The virtues of living men, the heroisms of every-day life, the deep significance of present events, the value of scientific discoveries, the helpfulness of new truth and of the re-statements of old truth, modern missionary movements, modern charities institutional and individual—these and other phenomena of religion and morality in our own day should be wisely and faithfully used.

The religious education of the present time is being given to the rising generation by a large number of agencies. The common notion that the home, the church and the Sunday-school are practically the only teachers of religion and morality is erroneous. These are certainly the primary agencies, but there are also the universities, colleges, and public and private schools of all grades; the Young Men's and Young Women's Christian associations; the Young People's societies of all sects and kinds; the libraries which are greatly extending and augmenting their effectiveness; and the public press, of which the religious papers exercise some influence upon a limited number of readers, while the daily press is now one of the greatest means of spreading religious and moral ideals.

Of general education in America the chief instrument is obviously the public schools. The entire period of development—childhood, youth and adolescence, from six to eighteen (or even to twenty-five) years of age, is now conducted by the state, which undertakes to bring the child into possession of the general knowledge, skill and character which are regarded as necessary to good citizenship. Increasingly the American people have turned their children over to state education, expecting it to develop them completely into manhood and womanhood. The home and the church contribute less than formerly to the education of the whole rising generation, because of the multiplicity of interests and the pressure of business on the modern home, and because of the obsolete or ineffective ideas and methods of many of the churches. The belief widely prevails that modern education is complete without that special religious training and knowledge of the Bible which previously were required. The argument runs thus: the education furnished by the state, under the direction of the ablest educators, may reasonably be understood to embrace all those elements of culture which are essential to a complete development of the young; and since the public schools make little or no specific use of the well-known means of religious and moral instruction, these should be considered as no longer necessary to a perfect education.

But the state should enlarge and improve its education in accordance with the best pedagogical ideas to meet our national needs; it should include in its aims and methods all those elements which are necessary to a full develop-

ment of men and women. Essential elements of education like religion and morality cannot consistently or wisely be left to other institutions to supply *in toto*, for two reasons: (1) these other institutions, such as the family and the church, often fail, wholly or in part, to make their proper contributions to the growth of the child; (2) no true education is possible where the essential elements are given in isolation instead of in correlation.

Certainly the home should follow a higher ideal and should achieve a greater efficiency; parents should anew consecrate themselves to the work of making the home the best possible environment for the growing child, where influence, instruction and stimulus will cause the best that is in the child to appear; particularly the religion and morality essential to the highest development should here enter into the environment so as to direct the growth of the child. The public schools cannot accomplish perfect results when they must do the work of the home in addition to their own.

The church also should set itself to learn its true function in the present time, and to discover how it can perform this. Some individuals and denominations of the church have made effort to adjust themselves to the progress of civilization, to the expanding ideas of modern thought, to the improved world-view, to the change of interest from speculation to actual life, and from an extreme individualism to a vastly better conception of men as interrelated and mutually dependent upon one another for higher development. But generally the churches have stood for the ideas, methods and viewpoints of the past; they have wished to confine advancing civilization within the bounds of previous centuries; they have sought to perpetuate doctrines and practices which were once expressive of current thought and experience and were therefore useful, but which have been superseded by clearer vision of truth, by a better interpretation of the Bible, and by changed ideas concerning the best way of doing things. The church is indeed the great conservative force in human civilization, and a conservative force is essential. But conservatism should not become obstructive, hindering growth and resisting progress.

The present movement for religious education, outside the practice of the Roman Catholic Church, which has always insisted on religious education, has come out of the educational world rather than out of the church, because of the inertia and narrowness of ecclesiasticism. It is inspired and guided by men who belong to the church and represent its best product, but whose life-work has been in the field of education. Certain branches of the church have made much of education; in America, in former years, the schools and colleges were often church foundations, to train the ministry and to spread intelligence in the interest of religion. But now the public schools have no relation to the churches; and many private schools which were formerly church schools have freed themselves from ecclesiastical supervision. The educational world has kept step with progress, and from it has come the demand that religion and morality shall be restored to their true place in educa-

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tion. This forward movement arose during the 19th century, gaining clearness and force as the sciences of psychology, pedagogy and history advanced, until with the opening of the 20th century the movement in America reached such a stage of development that a new era may be said to have been inaugurated.

The most conspicuous evidence of this was the establishment of the Religious Education Association at Chicago in February 1903, by one of the most remarkable conventions ever held in the United States. This representative national organization, in its second year only, consists of some 250 officers and 2,000 members, including many of the leaders in the religious and educational activities of our day. The purpose of the association is to unite for mutual helpfulness all those who are engaged in religious education through whatever agencies or means; to improve the current religious education by thought, conference and investigation; to promote such education by spreading approved ideals, principles and methods; and to increase the efficiency of all individuals and agencies by unifying, stimulating and developing all those forces which together can secure to religion and morality their true place and their proper influence. The association simply gives expression to the widespread popular demand that education shall make use of religion and morality according to the best light that has now been attained regarding these vital elements of human development. See PARISH SCHOOLS.

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Religious Liberty, or Liberty of Conscience, is the recognition and assertion by the state or government of the right of every man, in the profession of opinion and in the outward forms and requirements of religion, to do or abstain from doing whatever his individual conscience or sense of right suggests. Religious liberty is opposed to the imposition by the state of any arbitrary restrictions upon forms of worship or the propagation of religious opinions, or to the enacting of any binding forms of worship or belief. The limit of religious liberty is necessarily the right of the state to maintain order, prevent excesses, and guard against encroachments upon private right. The principle of religious liberty has come very slowly to be understood. The state of the ancient world in regard to questions of liberty of conscience was somewhat different from that of the modern. Many national religions did not make universal pretensions, and within their limits there was considerable latitude; the worshipper of one god did not necessarily impugn the authority of another. Yet instances of intolerance are to be found, as in the case of Socrates, even in the most liberal states. When Christianity appeared the case was altered, and it speedily drew on itself a treatment different from that which merely national religions had received from the rulers of the world. Christianity early developed within itself sects which did not manifest toward each other a very tolerant spirit; but it was only

when the civil power had been gained to its side that these differences could assume the form of open repression and persecution. It was then found that the persecuting spirit could distinguish a church not less than a secular government, and, indeed, that from the constant occupation of the former with religious affairs the danger of persecution from it was much greater than from the most intolerant civil government. In the organization of civil and ecclesiastical government which prevailed from Constantine to the Reformation persecution was in general only limited by dissent, and universal submission to the dominant church became the condition of religious peace throughout Christendom, while religious liberty was unknown.

The contest of opinion begun at the Reformation had the effect of establishing religious liberty, as far as it at present exists, but the principle itself was so far from being understood and accepted in its purity by either party that it hardly suggested itself even to the most enlightened reasoners of that age. The contest between the reformers and the church was primarily one of authority; and so great was the regard of the former to the authority of their own confessions, that in Germany itself the common dangers they encountered from the Roman Catholics could hardly keep the Lutherans and Calvinists united during actual hostilities.

In Great Britain even civil liberty, jealously maintained, was not understood, by the dominant party at least, to import religious liberty. Active measures of intolerance were adopted against Dissenters in the reign of Queen Anne. Even in the reign of George III. conditions were attached to the toleration of Dissenting preachers. It was not till the 53d year of this reign that Unitarians were included within the benefits of the toleration acts.

Religious liberty was introduced in Prussia by Frederick the Great, but contravened by his immediate successor. The state at present in Prussia, without, perhaps, actually dictating to private individuals, maintains a vigilant control over ecclesiastical organization, the education of the clergy, and all public matters connected with religion, which only do not affect religious liberty if they are strictly confined to state-protected churches.

Joseph II. of Austria found his Protestant subjects sufficiently advanced to be beyond the need of his control, and reserved such persecution as he was disposed to exercise for the Roman Catholics. By his religious reforms he excited a revolt among his Belgian subjects, which was only terminated under his successor. Religious liberty has only been established in Austria during the present reign. Italy first enjoyed the same advantage under Victor Emmanuel II. The government of France, even since the Revolution, has always been of so paternal a character that it is still somewhat doubtful on what foundation the liberties of Frenchmen rest. In Italy the Waldenses were emancipated in that year, 1848, which marks a new era of religious progress throughout Europe. The constitutions granted at that memorable epoch guaranteed the free exercise of divine worship. Since 1870 the Free Italian churches and many others have sprung into life. In Spain religious liberty dates its feeble beginnings from 1869. Concessions are neutralized by certain restrictions, for the con-

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stitution of 1876 limits the liberty of those who are not Roman Catholics to worship in private houses.

In Holland and Scandinavia, even with church establishments, perfect religious equality is enjoyed. And by the treaty of Berlin, 1878, the sultan's government was forced to this position, that in no part of the Ottoman empire shall difference of religion be alleged against any person as a ground for exclusion or incapacity as regards the discharge of civil and political rights, admission to the public employments, functions, and honors, or the exercise of the various professions and industries. The outrageous persecutions which have fallen on the Armenians in contravention of this treaty, and which the powers of Europe failed to prevent and punish, are among the burning shames of a century which won many victories for the right of rights.

The area of toleration has been enlarged by the official action of China in granting to the different European nations the right of sending Christian missionaries, not only to the port cities, but to the interior of that vast empire. The Chinese government has given repeated assurance of its belief that the doctrines of Christianity and the practice of them were for good. The fanatical uprising of those who hate all foreign influences will not permanently diminish the area of religious liberty in the Far East.

America is the great home not so much of toleration as of true liberty. In the United States the government has no authority to interfere with religion. The fullest liberty is possible only where the church and state are separate. From the beginning of our organized national life this separation has prevailed and been the fundamental law and practice of our country. Here the Jews have had freedom and have been treated with a friendliness never elsewhere shown to them. America is the standing reply to those who believe that religion needs the support and guidance of the state. Christian progress in our country has been more rapid than the progress of the population, and it is as true to-day as when De Tocqueville wrote that "there is no country in the whole world in which the Christian religion retains a greater influence over the souls of men than in America."

Probably in no other country than America could such a Congress of Religions have been held as that which was the crowning feature of the Columbian World's Fair at Chicago. By that remarkable gathering the bonds of brotherhood and of true toleration were enlarged. Roman Catholics and Protestants for the first time sat together in a great assembly for 17 days in the spirit of fraternity and kindness. The representatives of the great non-Christian faiths were treated with perfect courtesy, and illustrated the spirit of courtesy themselves. Many Christians learned a new lesson, following the teachings of Sir Monier Williams, not to shut their eyes to any truth or virtue which may be found in the non-Christian characters and non-Christian writings.

From this review it appears that toleration has been slowly advancing since the Reformation, and that its recent progress has been extensive. Even in the most advanced countries, however, the state of public opinion on this subject is still far from being satisfactory. Liberty

is correlative with responsibility, and as on philosophical grounds a man cannot be held responsible further than he is free, so in practical affairs no man can competently discharge his responsibilities who is denied freedom of action. Religion primarily concerns the conscience, which is the seat of human liberty, if that liberty exists anywhere. The value of religious observances depends upon their being the expression of religious thoughts and opinions. To compel a man who holds certain opinions to observe certain practices corresponding with them is to deprive him of the opportunity of giving free and natural expression to his opinions. If this is done in religion he is deprived of the natural outlet for his feelings of reverence and devotion. The spontaneity necessary to the discharge of his avowed responsibilities does not exist, and his religious life is thwarted and deadened. Thus compulsion in religion is injurious not only to those who resist, but still more to those who acquiesce; and freedom is indispensable, as much for the protection of those who are in the right as for those who, in the view of authority, are in the wrong. The religion which is imposed by authority is the religion of the rulers and not of the ruled. Consult: Johnston, 'Religious Liberty in Maryland and Rhode Island.'

Religious Orders. See **ORDERS, RELIGIOUS.**

Religious Sects. From the earliest days of the world's history man has been more or less a religious creature. Almost invariably he has had a god, or several of them, to whom he looked for protection. At times these gods have been crude fetishes of whittled wood or roughly hewn stone; at times they have assumed the form of animals or reptiles, or have appeared as cruel monsters eager for the life-blood of those who revered them. But, however they may have come, man has worshipped them, because religion, as represented in the worship of a supernatural power, is interwoven with the entire fabric of human nature. The religious "sect," however, is of more recent origin, for while primitive man could worship his crude fetishes blindly, it was necessary that he should learn to think before he could attempt to distinguish between the various attributes of the Infinite, that from them he might construct those well-marked divisions of faith, or creed, which are such an inevitable result of the varying phases of human thought. To-day the term "sect" is applied to those bodies of men who have announced their decisions to follow the opinions or doctrines of some philosophical or theological teacher. Of course, to the Roman Catholic all religious bodies that are not actually in affiliation with her communion are classed as sectarian, but such a definition is not the general one, the word "sect" being used to differentiate separate organizations rather than to call attention to comparatively inconsequential differences of opinion. Thus, for example, the High and Low Church factions in the Church of England, or, in this country, the Protestant Episcopal Church, are not regarded as separate sects but as parties, or schools, within the same communion; whereas the various bodies of Baptists in America are denominated as "sects," not so much because of their differences in doctrinal matters, which in some instances are slight, but for the reason that they are under

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separate church government. While there were sects among the ancient Jews and Greeks the coming of Christianity, with its wide field for speculation, opened the way for a more general promulgation of individual opinion, and the following list of the most important organizations of this and other days indicates that there has been no lack of teachers and prophets to preach new gospels to those who would hear:

Abecedarians.—A sect of German Anabaptists, led by Nicholas Stork, a weaver, who opposed the simplest forms of education, even the learning of the A B C's, on the ground that it prevented divine illumination and hindered spiritual sanctification. Extinct.

Abelites.—An African sect which opposed procreation on the ground that it was a perpetuation of sin. Extinct.

Abrahamites.—An obscure Bohemian sect of deists. Its members rejected all distinctively Christian doctrine, with the exception of the Lord's Prayer, which they used, adopting the tenets of the religion of Abraham as contained in the Decalogue. Extinct.

Abyssinian Church.—That branch of the Christian Church that has been established in Abyssinia for many centuries. It is in agreement with the Coptic Church concerning its ritual and practice, but differs from it slightly in its theological position.

Acacians.—An Arian sect which occupied a theological position half way between the Semi-Arian and the extreme Arian, or Anomæan sects. Extinct.

Adamites.—Several attempts have been made to revive the sect of Adamites, which was first suppressed in the 2d century. Its pretensions are that its members have attained the primitive purity of Adam and are, therefore, able to dispense with marriage and to go without clothing at their meetings, which are called "paradises." Upon each appearance it has been prescribed, the last attempt at rejuvenation having been in 1848-9.

Adelphians.—A branch of the Euchite sect. Extinct.

Admonitionists.—The followers of Thomas Cartwright, who, in 1572, advocated the government of churches by presbyters instead of bishops and who urged the right of the church to hold supremacy over the state. Extinct.

Advent Christian.—The largest branch of Adventists. Absolutely millennial in character, it teaches the final extinction of all evil as well as the renewal of the earth that it may become the future abode of the saints. (See ADVENTISTS.)

Aerians.—A reforming sect in the 4th century now sometimes considered to have been a forerunner of modern Presbyterianism. The members declined to permit prayers for the dead, repudiated the church fasts, and made the authority of the presbyters equal to that of the bishops. Extinct.

Age-to-Come Adventists.—One of the many sects of Adventists. Its members believe that at the time of the millennium Christ will assume a personal rather than a spiritual rule over the earth which, they hold, will not be destroyed at the Second Coming. (See ADVENTISTS.)

Agnostics.—While unorganized as a sect agnosticism teaches the theory that it is impossible for man to attain to any definite knowledge of the divine power.

Aitkenites.—A party which was founded in the Church of England about the year 1850, by Robert Aitkens, a ritualistic clergyman. It was an attempt to graft a portion of the tenets of Methodism upon the High Church school of ritualistic and sacerdotal theology.

Albaneses.—A mediæval sect closely allied to the Albigenes. Extinct.

Albigenses.—A name applied to the anti-sacerdotal sects that revolted from the Church of Rome during the 12th century. They were vigorously persecuted and finally exterminated.

Allenites.—The followers of Henry Allen, who preached the peculiar doctrine that all souls were actually present at the Garden of Eden where they participated in the fall of Adam. Extinct.

Alogians.—A name applied to a heretical sect of the 2d century because of its rejection of the doctrine of the Logos and the Gospel of Saint John.

Amalricianism.—A pantheistic heresy promulgated by Amalric of Bene, professor of logic and exegesis in the University of Paris. Extinct.

Amyraldists.—A sect of Calvinists who followed Moses Amyraut in his attempt to reconcile the disputes concerning predestination and divine grace.

Anabaptists.—A name most generally applied to those bodies of extreme anti-sacerdotalists which re-

quired re-baptism from those who had been baptized in infancy and who were often over-zealous in their repudiation of certain doctrines of the 16th century Church. For many years the term was seldom used except as one of opprobrium.

Angel Dancers.—A small sect of vegetarians founded about 1890 by Huntsman T. Mason, who claimed to be the reincarnation of the spirit of Saint John the Baptist.

Angelic Brothers.—A community of Dutch pietists founded by George Gichtel in the 16th century. Its members held that, having attained a state of angelic purity, they should give no further thought to marriage. Extinct.

Anglicans.—One definition for the High Church school in the Episcopal Church.

Annihilationists.—The name applied to those sects which teach the absolute destruction of the wicked.

Anomæans.—The extreme sect of Arians, it taught that the Son was of an essence which was not even similar to that of the Father. It existed during the 4th century.

Ansarians.—A sect whose membership is almost entirely restricted to a small district in Syria. As a religious belief it is a combination of Mohammedanism, paganism and something that somewhat resembles Christianity. This strange faith is said to have first been taught by Nusari, a prophet and saint who lived at Nasai, near Koufa, in the latter part of the 9th century, and his gospel included the doctrine of metempsychosis as well as that of divine unity in three personalities, the second and third being created. This sect now receives both the Old and New Testaments, the Koran, and several apocryphal works as its inspired scriptures.

Antiburghers.—A name applied to one of the two factions into which the Scottish Secession Church was split in 1747. The controversy was based upon the lawfulness of a clause in the oath required to be taken by burgesses, but, while the point was fiercely contended for several years, the two factions were reunited in 1820.

Anti-Mission Baptists.—A sect which is theologically in accord with the regular Baptists but that is opposed to missions, Sunday schools, and other educational and evangelistic enterprises.

Anti-pedobaptists.—A name sometimes applied to sects that are opposed to the doctrine of infant baptism.

Aphthartodoceta.—A sect which became extinct about the 9th century. It held that the body of Christ was incorruptible even before the resurrection and that his suffering of death was merely a phantasma.

Apollinarians.—A sect condemned during the 4th century for having denied the proper humility of Christ.

Arians.—The followers of Arius, the Alexandrian priest who promulgated a widespread heresy during the 4th century. Denying the divinity of Christ and other fundamental doctrines of the Christian Church, he was condemned and Arianism was suppressed by order of the early councils. Since that time, however, the doctrines taught by Arius have been frequently revived and they still exist under other designations.

Armenians.—Although the separation of the Armenian Church from the main body of Christians, which occurred at the time of the Council of Chalcedon (451 A.D.), was the result of a comparatively inconsequential misunderstanding, it has been maintained to this day, in spite of the several attempts at reconciliation.

Arminians.—A name sometimes applied to the anti-Calvinistic sects of Protestants which teach the doctrine of universal salvation.

Artotyrites.—A sect existing in the early days of the Church. It admitted women both to the priesthood and the episcopate and taught the use of bread and cheese in the eucharist on the ground that it was right that man's oblations should be of the fruits of the earth and of the flocks.

Atheists.—The term applied to those persons who deny the existence of God.

Baanites.—A Paulician sect of the 8th and 9th centuries. Extinct.

Babists.—The followers of Mirza Ali Muhammad of Shiraz, who founded a new religious system in Persia during 1844. Described as a "Pantheistic offshoot from Mohammedanism, tinctured with Gnostic, Jewish, and Buddhist ideas," the high form of morality which it teaches has appealed so strongly to the Western mind that its converts in America alone during the past few years undoubtedly number several thousand. Among other doctrines Babism teaches the equality of the sexes.

Baptists.—Those sects which oppose infant baptism, administering the rite only to adult persons, and then baptizing them not to make them children of God, but as a sign that they themselves have accepted Him. (See BAPTISTS, and BAPTISTS IN AMERICA.)

Beguni.—A fanatical Russian sect which preaches

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and, it is feared, sometimes practises the rite of human sacrifice as a means of justification before God.

Besopofschins.—Many sects of Russian dissenters depend upon an independent ministry, rejecting the office of priest, or "pope." They are designated as Besopofschins.

Bible Christians.—See BRYANITES below.

Bohemian Brethren.—A Hussite sect which was quite numerous in Bohemia but which ceased to exist at the end of the 17th century.

Booldo.—The Buddhism of Korea, which differs but slightly from that of China.

Borrelists.—A sect of Mennonites whose worship is devoid of all external ordinances.

Bourignonists.—A sect of Quietists founded by Antoinette Bourignon, a pietist who claimed to be the subject of divine inspiration, in the 17th century. Extinct.

Brahmanism, or Hinduism.—This religion, which is the oldest faith that has sprung from the Aryan family, derives its name from that of its chief caste, from which alone, the priests are selected.

Brahmo-Somaj.—A monotheistic Hindu sect which apparently owes its origin to the contact of Brahmanism with the various anti-sacerdotal forms of Christianity represented by the missionaries.

Broad Churchmen.—A designation often applied to a school of thought in the Protestant Episcopal Church, the members of which are inclined to give considerable latitude to individual opinion in the rejection or acceptance of beliefs.

Bryanites.—Otherwise known as "Bible Christians." A sect which is in general theological accord with Methodism, but which permits women to preach.

Buchanites.—The followers of Elspeth Buchan, or Simpson, a religious enthusiast in Scotland who claimed to be the woman of Revelation in whom the light of God was restored to men. Extinct.

Buddhism.—The reform movement which originated in India, some 2,500 years ago. It was a protest against the religious and social despotism of Brahmanism, and, while atheistic in theory, teaching that release from existence, or absorption into the infinite, is the great good to which man should look forward, it has exercised an elevating effect upon the social and moral conditions of the countries where it has been accepted. It is still the religious faith of about one third of the human race.

Cainites.—A fanatical Gnostic sect of the 2d century. Its members revered such personages as Cain, Esau, and Judas Iscariot. Extinct.

Calendar Brethren.—A religious society, which, while once prominent, now exists only in Brunswick. It derives its name from the fact that its meetings are always held on the Kalends, or the first day of the month.

Calvinists.—A designation applied to those Christians, in various sects, who follow John Calvin in his opinions regarding the ministry, the sacraments, and divine grace, as exploited in his doctrines of "Election" and "Particular Redemption."

Campbellites.—The followers of Rev. John McLeod Campbell, who taught the universality of the atonement and who held that Christ's death was in no sense a vicarious satisfaction of divine justice. He was condemned as a heretic by the Presbytery of Dumbarton in 1830.

Campbellites, American.—Otherwise known as Disciples of Christ, or as Reformed Baptists. A Baptist sect founded by Rev. Thomas Campbell. Congregational in discipline it insists upon baptism by immersion as the requirement for admission to its membership. (See CHRIST, DISCIPLES OF.)

Catholic Apostolic Church.—See IRVINGITES.

Christadelphians.—Otherwise known as Christ's Brethren. A sect of modern origin which has assumed its name to distinguish it from other bodies of Christians whom it regards as apostates. Quite similar to Unitarianism in its doctrines it still insists upon baptism by immersion. (See CHRISTADELPHIANS.)

Christian Catholic Church.—(See DOWIE.)

Christian Connection.—A sect which accepts no earthly leaders and which denies the inspiration of all creeds. Its members are permitted to be guided entirely by individual interpretation of the Holy Bible.

Christian Israelites.—A small sect, the members of which are anticipating the immediate second-coming of Christ.

Christian Scientists.—The followers of Mrs. Mary Baker Eddy, who, about 1866, promulgated a system of theosophic and therapeutic doctrine. Mrs. Eddy, in her book, "Science and Health," based her theories upon the Bible, teaching that as man's essential nature is spiritual and the Spirit of God, Love and Good, any moral and physical evil must be contrary to that Spirit, representing the absence of the True Spirit which was in Jesus Christ. (See CHRISTIAN SCIENCE.)

Christian Union.—A denomination recently organized at Columbus, Ohio. Its members hope to reunite all Christian bodies on the basis of the Bible.

Christians.—Several small sects have from time to time assumed the title "Christians," to indicate that they alone are possessed of true Christianity.

Christ's Brethren.—(See CHRISTADELPHIANS.)

Christ's Sacram.—A religious society founded in the 18th century to work for the reunion of all Christian bodies. Practically extinct.

Church of God.—Otherwise known as Winebrennarians. A small body of Baptist Christians, which accepts no authority, or creed, except that contained in the doctrines exploited by its founder, John Winebrennan. (See CHURCH OF GOD.)

Church of God in Jesus Christ.—(See ADVENTISTS.)

Church of the New Jerusalem.—(See SWEDENBORGIANS.)

Coglers.—A sect of total abstainers whose chief tenet is that its members are morally incapable of committing any sin.

Collegians.—A sect which, founded in the 17th century, is still well represented in The Netherlands and in some parts of Germany, deriving its name from the fact that its assemblies are known as colleges. Its theological position is practically that of the Quakers, plus baptism by immersion.

Collegiate Church.—The corporate name of a branch of the Reformed (Dutch) Church which occupies an important position among the religious bodies of New York.

Confucianism.—Although one of the popular religions of China, Confucianism is in no sense a religious system, its only worship being what may be defined as a religious veneration of ancestors. Instead of doctrines it presents instructions as to the proper mode of life, the discrimination between virtue and vice; the duty of compliance with the law of following the dictates of the conscience, etc.

Congregationalists.—An evangelical sect which derives its name from its fundamental principle in discipline, that each particular congregation is an independent body, having the right to elect or depose its pastors, settle all disputes regarding matters of faith, and exercise necessary discipline over its members without the interference of other congregations.

Copts.—The name applied to the Jacobite Church in Egypt, which has now almost entirely supplanted the Orthodox Church.

Cumberland Presbyterians.—A sect which withdrew from the Presbyterian Church in 1810 because of the refusal of that body to recognize as ministers persons who had been admitted without the usual educational preparation and who refused to subscribe to the Calvinistic doctrine of "Election." (See PRESBYTERIAN CHURCH.)

Deists.—Those who believe in the existence of God, but who accept few if any other of the doctrines of the Christian religion.

Devil Worshipers.—(See SATANISTS and YEZER-DEES.)

Donatists.—An early Christian sect in Africa. Its members held that they alone constituted the true church and that any offices performed by other clergy were invalid. Extinct.

Dowieites.—Otherwise known as "The Christian Catholic Church." A sect primitive in creed, the members of which believe in the healing of disease by prayer. It was founded about 1802 by John Alexander Dowie, the present General Overseer, who professes to be the reincarnation of the Prophet Elijah.

Druses.—A fanatical sect found chiefly in the mountainous regions of Syria. Their name is derived from that of their first apostle, Ismail Darazi, or Durzi. Little is known concerning their belief, their reputation for fanaticism being based upon the blood feud which they have long maintained against their Maronite neighbors.

Dukhoborts.—A Russian sect which originated in the early part of the 18th century. It has been subjected to repeated persecutions both because of its religious doctrines and for the refusal of its members to abide by the laws of the country.

Dunkards.—Otherwise known as Brethren. An American sect of extremely primitive Baptists which was founded by a party of German emigrants in the 18th century. In addition to a dress which is peculiar to themselves, its members maintain such customs as the washing of feet and the anointing of the sick with oil. (See DUNKARDS.)

Ebionites.—A sect of Judaizing Christians which became extinct about the 4th century. They recognized Christ as the Messiah, but denied his divinity and repudiated the writings of the apostles, accepting the Mosaic law.

Elcesaites.—A Jewish Christian sect very similar in doctrine and practice to the Ebionites. Extinct.

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Encratites.—The name applied to those members of the early Church who refrained from marriage as well as the use of wine and flesh meat. Extinct.

Enochites.—A millenarian sect in Russia. It teaches that the Prophet Enoch has already returned to earth and that his personal manifestation will be the signal for the destruction of all matter.

Ensarians.—See ASARIANS.

Erastians.—The followers of Thomas Erastus, who proposed several restrictions regarding the jurisdiction of the Church. Extinct.

Euchites.—A 4th century sect sometimes known as Euthusiasts. Its members lived a life of prayer and asceticism and repudiated the sacraments and moral law. Extinct.

Eunomians.—A sect of extreme Arians. Extinct.

Eusebians.—The followers of Eusebius of Nicomedia, who effected the restoration of Arius in 334. Extinct.

Eustathians.—The orthodox sect in Antioch during the 4th century. Extinct.

Eutyrians.—The members of a sect condemned for heresy in the 5th century. They taught that Christ was possessed only of a divine nature. Extinct.

Evangelical Adventists.—The original sects of Adventism. Its particular belief is in the conscious state of the dead and, necessarily, the conscious suffering of the wicked. Like other Advent sects it is millenarian. (See ADVENTISTS.)

Evangelical Association.—A sect whose belief is like that of the Methodists except that it rejects the doctrine of original sin. (See EVANGELICAL ASSOCIATION.)

Evangelicals.—A designation sometimes applied to the Low Church party in the Episcopal Church.

Fetichism.—The lowest grade of idolatry, taking the form of a worship of some material object to which a supernatural power is ascribed.

Fire Worshipers.—A designation by which the Parsees are sometimes known.

Flagellants.—The victims of a hysterical mania which spread over almost every portion of Europe during the Middle Ages. Its devotees held that in flagellation was the only means to salvation, but their use of the scourge was finally suppressed by the ecclesiastical powers.

Flemings.—Otherwise known as "Fine," or rigid Mennonites, because they profess to maintain more ancient rites and stricter principles than those followed by ordinary Mennonites. Among these ancient rites is that of feet washing.

Foism.—The official name for the Buddhism of China. Its worship includes that of many gods which are peculiar to itself.

Fratricelli.—A sect which had its origin in a reformation of the Franciscan order in the 13th century. Its members devoted themselves to prayer, rejected the sacraments, and held that the ideal Christian condition was one of poverty. Extinct.

Free Church of England.—A name which has been assumed at various times by sects which have seceded from the Church of England. They have had no affiliation, however, either in principles or practice.

Free Kirk of Scotland.—A name assumed by that body of Presbyterians which seceded from the Established Church of Scotland in 1843. The only points in which it differs from the older body are in matters of patronage and the question of the right of the state to interfere in church affairs.

Free Will Baptists.—A sect which withdrew from the Baptist communion in 1780, chiefly because of its rejection of the Calvinistic doctrine of election.

Friends of Light.—A sect of Rationalistic Lutherans. It taught that complete intellectual freedom in religious belief could not be obtained except when individual judgment was permitted to be the sole guide of the conscience.

Friends, Society of.—(See QUAKERS.)

Galenists.—A Mennonite sect founded in 1664 as the Arminian branch of the Waterlans.

Glassites.—(See SANDERMANIANS.)

Gnostics.—The name applied to the Rationalistic sects which flourished between the 2d and the 6th centuries. They rejected the literal translation of the Scriptures, held that God was unknowable, that Christ was a superior æon who had come to subdue the æon of this world, and insisted that knowledge instead of faith was necessary to salvation. Extinct.

Greek Orthodox Church.—The name applied to the communion which since its separation from Rome, has acknowledged the primacy of the Patriarch of Constantinople.

Gymnosophists.—An ascetical sect of Hindu philosophers who lived as hermits that they might better devote themselves to silent contemplation. Extinct.

Hanafites.—The oldest of the four orthodox sects of Sunnite Mohammedans.

Harmony Society.—A communistic religious body composed of members of the German Pietist sect, the Separatists, which emigrated to the United States in 1803 and founded a colony in Pennsylvania, the model for which was the primitive church. After removing to Indiana in 1815, they returned to Pennsylvania in 1825, when they founded the township of Economy and the new village of Harmony. Communistic in character, they hold all property in common, discourage matrimony, and look for the early second-coming of Christ.

Hattemists.—A sect founded in The Netherlands in the 17th century. Its members denied the expiatory sacrifice of Christ and held that sin can exist only in the imagination. Extinct.

Henricians.—A sect of religious reformers that originated in Switzerland during the 12th century. Extinct.

Heracleonites.—A Gnostic sect of the 2d century. Extinct.

Hicksites.—Those who followed Elias Hicks in his separation from the main body of the Society of Friends in 1827. They deny the divinity of Christ and repudiate the doctrines of the Atonement and the Trinity.

High Churchmen.—Otherwise known as Ritualists. A designation applied to those members of the Episcopal Church who exalt the authority of the Church and give prominence to the sacerdotal aspect of the priestly office.

Hinduism.—The name applied to the modern religious beliefs which have developed from Brahmanism.

Holy Ghost and Us, Society of the.—Otherwise known as "The Church of the Living God." A sect which, millennial in character, teaches the cure of disease by faith and professes to follow a literal interpretation of the Scriptures.

Holy Rollers.—A designation applied to a small sect because of the peculiar habits of its members who roll upon the ground during their religious ecstasies.

House of Israel.—An obscure sect of American millenarians.

Huntingdonians.—A sect of Calvinistic Methodists, congregational in policy, which was founded by Selina, Countess of Huntingdon, after her withdrawal from the Wesleyan communion.

Huntingtonians.—A sect founded by William Huntington, known as the "preaching coal-heaver," who laid great stress upon the doctrines of faith and indefectible grace. Practically extinct.

Hutchinsonians, English.—The followers of John Hutchinson, who, accepting the Bible as the source of all science and all philosophy, opposed the system of Newton and all other scientific theories that could not easily be reconciled with their belief. Extinct.

Hutchinsonians, American.—The followers of Mrs. Anne Hutchinson, who taught the Antinomian doctrines in the Massachusetts Colony soon after its foundation. Extinct.

Independent Methodists.—A title assumed by several independent congregations of Calvinistic Methodists.

Inghamites.—A religious denomination founded in England in the 18th century by Benjamin Ingham, who taught a peculiar combination of Methodism and Moravianism. Extinct.

Irvingites.—Otherwise known as "The Catholic and Apostolic Church." A sect founded in 1831, its doctrines being based upon the teachings of Edward Irving, who held that by a new "outpouring" of God through the Holy Ghost the prophetic and apostolic offices had been re-established. Its ritual is very elaborate.

Jacobites.—A sect of Christians in Asia, the members of which have remained true to the Monophysite doctrines. Its churches include three patriarchates, those of Antioch, Armenia, and Alexandria.

Jains.—A non-conformist Hindu sect, the members of which believe that every object in the world, including plants and minerals, as well as men and animals, possesses souls.

Jansenists.—A school of thought established in the Roman Catholic Church by Cornelius Jansen during the 17th century. It has frequently been the subject of the condemnation of the ecclesiastical authorities.

Jerkers.—A name, usually a term of opprobrium applied to those sects whose members are in the habit of indulging in violent exhibitions of religious fervor on the occasion of revivals or other special meetings.

Joachimites.—A mystical sect which existed until some time in the 13th century. Its members believed that the earth was passing through the third and last period of its existence and that a new gospel would soon appear to supersede the Old and New Testaments.

Julianists.—A sect in the 6th century. It held that the body of Christ was incorruptible. Extinct.

Jumpers.—A name which was first applied to the Methodists of Wales because of their peculiar actions during times of religious frenzy.

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Kabbalists.—Those who are devoted to the Kabbala, or the theosophical or mystical philosophy of the Hebrew faith.

Kabirpanthis.—The followers of Kabir, a Hindu reformer, who denounced idol worship and preached that the only religion was devotion to one god, irrespective of the name by which that god might be known.

Karaites.—Otherwise known as "The Karim," or "Scripturists." A Jewish sect which adheres strictly to the Scriptures, rejecting the authority of the Kabbala as well as the Talmuds.

Kilhamites.—A name often applied to the followers of Alexander Kilham, the founder of the "New Connection of Wesleyan Methodists."

Labadists.—A sect of Christian communists which existed until the middle of the 18th century. Its members upheld the doctrines of Jean de Labadie, who taught that as life was a perpetual sabbath, the observance of a particular day was unnecessary and that marriage as a holy ordinance was not valid unless both parties to it were believers, in which case the children of such unions were born without the taint of original sin.

Lamaism.—The Buddhism of Tibet, which teaches that the soul of Buddha is always present, incarnate in the body of the Grand Lama.

Latter Day Saints.—(See MORMONS.)

Leonists.—Same as Waldenses.

Lesghians.—A Mohammedan sect living in the Caucasus.

Life and Advent Union.—A sect which is similar to regular Adventism except that it holds that the souls of the wicked are exterminated and will not be present with the saints at the day of resurrection. (See ADVENTISTS.)

Lollards.—Otherwise known as "Bible men." The followers of Wyclif in England during the 14th century. Extinct.

Low Churchmen.—The designation applied to that branch of the Episcopal Church, the members of which strive to avoid anything savoring of sacerdotalism and whose chief regard for the ministry and the sacraments is based upon their relation to the religious life of mankind.

Lucianists.—The members of a Marcionite sect which existed during the 2d century. They held that while some representation of the soul and body would appear at the resurrection, the actual soul and body would not participate in that event. Extinct.

Lutherans.—Although there have been many changes in the various branches of the Lutheran Church since the days of Luther the doctrines which he promulgated in the 16th century are the basis for the beliefs of all the sects which bear his name and which are now represented in almost every part of the Old and New Worlds. The title is also applied to all followers of that 16th century reform movement which cost the Roman Catholic Church so large a part of the Teutonic and Scandinavian constituency. (See LUTHERAN CHURCH IN AMERICA.)

Macarians.—A monothelitic sect founded by Macarius, patriarch of Antioch, in the 7th century. Extinct.

Macedonians.—A sect founded by Macedonius, bishop of Constantinople, in the 4th century. Its members denied the Godhead or distinct existence of the Holy Spirit, claiming that the supposed third person in the Trinity was no more than a divine energy which God had diffused through the universe. Extinct.

Malakanes.—A millenarian sect in Russia, the members of which reject all sacraments.

Mandaans.—An Eastern sect that has never extended beyond Persia and Arabia. Its members are known as "Disciples of Saint John the Baptist," and, from the Christian point of view, their Christology is of a most heretical character.

Marcellians.—Followers of Marcellus, bishop of Ancyra, in the 4th century. They held that the Holy Spirit was merely an impersonal agency of God. Extinct.

Marcellinists.—A Gnostic sect of the 2d century. Extinct.

Marcionites.—An ascetic Gnostic sect of the 2d century. Its members rejected the Old Testament and denied both the incarnation and the resurrection. Extinct.

Maronites.—The ecclesiastical name for a Syrian tribe inhabiting the slopes of Lebanon. In the early days the Maronites followed the monothelite heresy, but, in 1445, they were reunited to the Roman communion, although they have continued to retain their own liturgical customs, just as they elect their own patriarch.

Martinists.—A school of religionists, or kind of pietist freemasonry, instituted by Chevalier Saint Martin. Among other peculiar doctrines the founder taught that man is antecedent to nature, having existed in

spirit, of the same essence as God Himself, prior to his existence in body.

Massilians.—The members of a Semi-Pelagian school once numerous in France.

Materialists.—Those who hold that matter is the first and only principle and that mind is the derived result.

Melchites.—The name by which the orthodox Egyptians are distinguished from the Jacobites.

Meletians.—A 4th century sect, followers of Meletius, a schismatic Egyptian bishop. Extinct.

Men, The.—The name applied to a class of lay preachers who frequent the Scottish Highlands. They wear a distinctive dress and are in direct opposition to the Kirk in all their ministrations.

Mennonites.—A general designation for those sects which were known as Anabaptists until the time of their reformation by Menno, in the 16th century. (See MENNONITES.)

Methodists.—A general designation for those sects which are more or less the outcome of the institution of John Wesley's confraternity, in 1739. The parent sect was known as Wesleyan Methodists, but many other important branches have been organized since that time, including the Methodist Episcopal Church, Methodist Reformed Church, Methodist Protestant Church, Union American Methodist Episcopal Church, Methodist Episcopal Church South, Congregational Methodist Church, New Congregational Church, Primitive Methodist Church, Free Methodist Church, Independent Methodist Church, Methodist Connection, and various African and Zion Methodist branches, which are composed of colored persons. (See METHODISM IN AMERICA.)

Michaelhahnites.—A pietist and millenarian sect organized by Michael Hahn after his separation from the Evangelical Lutheran Church of Wurtemberg. Extinct.

Millenarians.—A general designation for those Christians who anticipate the early second-coming of Christ. There are many bodies of millenarians, all professing different doctrines, the more extreme asserting that the dead will finally be restored to life, including all its bodily pleasures, on earth.

Mohammedans.—The followers of the Prophet Mohammed, who began to propagate his faith in Arabia in 611. The name which was given to this religion by its founder was "Islam," one meaning of which is "to submit wholly to God and to acknowledge Him only as Lord." The entire Mohammedan faith may be briefly explained by reference to its two articles: (1) "There is no God but God," and (2) "Mohammed is His Prophet," a proposition the acceptance of which makes every doctrine of divine authority.

Molinists.—There have been two sects which have borne the name of Molinists: (1) Those who agreed with Luis Molina regarding the doctrines of free will and predestination, and (2) the followers of Miguel Molinos, the Spanish mystic who taught the doctrine of the direct relationship between the soul and God. The latter were also known as Quietists. Both are extinct.

Monarchians.—A designation applied to those who deny the distinction of persons in the Trinity.

Montanists.—A 2d century sect, the followers of which believed in the divine and prophetic inspiration of Montanus of Phrygia. Extinct.

Moravians.—Otherwise known as Moravian Brethren. A sect which occupies a theological position which is almost identically that of the Evangelical Lutheran Church. Formerly affiliated with the Taborites, it withdrew from that communion during the 15th century.

Moreltschiki.—A fanatical Russian sect whose practices are said to be in keeping with its name, which means "self-immolators."

Mormons.—Otherwise known as Latter Day Saints. A religious system organized by Joseph Smith, who claimed to have found his inspiration in a "Book of Mormon," which he had unearthed and translated. The doctrines have been further extended by later revelations, one of which, the "Celestial Law of Marriage," which was promulgated in 1852, and which authorized the practice of polygamy, having resulted in a reform movement which brought about the secession of a large body of Mormons who assumed the name of the "Reorganized Church of Jesus Christ of Latter Day Saints." (See MORMONS.)

Muggletonians.—An English sect founded in 1651 by Lodowick Muggleton and John Reeve, who claimed to be the two witnesses referred to in Revelations. They insisted that they were divinely inspired and taught many doctrines peculiar to themselves. Extinct.

Mystics.—The general designation applied to those who believe that a rapt soul may enter into union with the divine by means of ecstatic contemplation.

Naumbergers.—An obscure evangelical sect which carries the simplicity of its dress to such extreme as to use hooks and eyes instead of buttons.

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Nazarenes.—A 4th century sect of Jewish Christians. While observing the Mosaic ritual they accepted the divinity of Christ and looked for his early second-coming.

Necessitarians.—A general designation applied to those who believe that a fixed and unchangeable law governs everything.

Nestorians.—The followers of Nestorius, who denied the hypostatic union of the two natures in the one person, Christ. Two sects of Nestorians, the remnants of the once-powerful denomination, still exist, one in Turkey and Persia, and the other in India.

Netovitschins.—A sect of Russian dissenters who believe that antichrist has commenced the ruin of the Church and that all holiness is gradually being extinguished.

New Jerusalem Church.—(See SWEDENBORGIANISM.)

New Lights.—A designation sometimes applied to the Free Will Baptists and Separatists.

Niobites.—A monophysite sect which was finally absorbed into the orthodox communion. Its members held that the human nature of Christ was lost in its union with his divine nature.

Non-conformists.—A designation sometimes applied to various sects of Protestant dissenters.

Noctians.—The followers of Noetus, a 2d century heretic, who held that Christ was the actual embodiment of the Father and that it was the Father Himself who was born and had suffered death on the cross.

Novations.—An austere 3d century sect which was absorbed by the mother church before the 6th century, its differences having been chiefly in regard to matters of church discipline.

Oahspe.—A sect of American vegetarians, extremely primitive in character. Its tenets prohibit divorce and second marriage and its members are not permitted to have recourse to law.

Old Catholic.—A movement inaugurated in Germany as a protest against certain dogmas of the Roman Catholic Church.

Old Lutherans.—The name applied to those Lutherans of Prussia who have refused to enter into affiliation with the United Evangelical Church.

Old School Baptists.—The name assumed by a religious sect which still maintains the strict doctrines of Calvinism.

Old Two-Seed-in-the-Spirit Predestinarians.—A strictly Calvinistic sect of American Baptists.

Omish Church.—The name applied to a strict sect of primitive Mennonites.

Ophites.—A Gnostic sect which held that the serpent that tempted Eve was the impersonation of divine wisdom.

Osiandrians.—The followers of Osiander, a 16th century theologian who taught that the attainment of the essential righteousness of Christ was necessary to justification by faith.

Pantheists.—The members of a philosophical school which teaches that God is in everything and that everything is God.

Parsees, or Parsis.—The followers of Zoroaster, who founded the ancient religion of Media and Persia, about 1000 B.C.

Paulicians.—A sect founded in the 7th century, the members of which held that all matter is evil and that Christ had a purely ethereal body and suffered only in appearance. Extinct.

Peculiar People.—A sect which in almost every respect resembles the Dunkards.

Pelagians.—A sect which held that there was no original sin, but that each soul was created sinless and free. Extinct.

Peremayanoftschins.—A sect of Russian dissenters which requires the re-ordination of the clergy.

Perfectibilists.—A name applied to those who hold that absolute perfection is attainable during the present life.

Perfectionists.—The name assumed by an American sect established by John Humphrey Noyes, in 1845. In addition to teaching perfect holiness through complete reconciliation with God, its founder maintained the equality of the sexes and the community of goods.

Picards.—A sect suppressed in the 15th century because of alleged immoralities. They held that salvation was obtainable only through the restoration of man's primitive innocence.

Pietists.—A general designation applied to those who claim to be possessed of extreme piety.

Plymouth Brethren.—A sect which holds the two doctrines of Predestinarianism and Millenarianism and which does not maintain a separate ministry.

Pemorane.—A sect of Russian dissenters which has no separate ministry and which requires re-baptism of converts.

Popofschins.—That branch of Russian dissenters which continues to maintain the office of priest, or "pope."

Positivism.—A modern school of skepticism, founded by Auguste Comte. As a religion Positivism is nothing less than the worship of humanity; as a philosophy, it teaches that nothing should be accepted as true unless it can be positively demonstrated.

Predestinarians.—A general designation applied to those who believe that each soul is predestined for heaven or hell from all eternity.

Presbyterians.—The name assumed by a denomination which maintains that the ministry of the Church should consist of but one order, that of presbyters, or elders. Its creed, which has been Calvinistic since the establishment of the denomination, is now, in some places, in process of alteration.

Princeites.—A small English sect established in 1840 by Henry James Prince, who professed that his person represented a new dispensation of the Holy Ghost by which the dispensation of Christ was to be superseded. It is now practically extinct.

Protestant Episcopal Church.—The American representative of the Church of England, the denomination which led in the protesting reformation of the Roman Catholic Church in that country. In addition to its creeds it adopts the principles of the Thirty-nine Articles and makes use of the Book of Common Prayer. (See PROTESTANT EPISCOPAL CHURCH.)

Puseyites.—The name sometimes applied to the High Church school in the Episcopal Church, from that of Dr. Pusey, who was one of the leaders in the "Tractarian" or ritualistic movement.

Pyrrhonists.—The designation applied to that school of extreme skepticism which denies the possibility of attaining with certainty any absolute truth.

Quakers.—Otherwise known as Friends, or as the Society of Friends. A sect founded by George Fox. Its members reject all sacraments, possess a mixed but not settled ministry which depends upon the inspiration of the Holy Spirit for its utterances, and refuse to participate in wars or to take oaths. They also maintain a peculiarity of dress and a simplicity of speech which is quite in keeping with their life of peace and meditation. (See FRIENDS, SOCIETY OF.)

Quietists.—A designation often applied to a school of mysticism, the followers of which profess to resign themselves passively to what they regard as divine manifestations. The name is also applied to certain distinctive sects like the Bourignonists and Molinists.

Rabbists.—(See HARMONY SOCIETY.)

Rationalists.—Those who maintain that reason is the one test of truth in matters of religious faith and who are guided by this theory in their interpretations of the Bible.

Reformed Dutch Church.—The Reformed Protestant Dutch Church which was instituted in the Netherlands during the 16th century. In 1561 it adopted a confession of faith, known as the Belgic confession, which was prepared by Guido de Bres, who took for his model the Calvinistic confession of the Church of France. This body was the first Reformed Church instituted in the American colonies.

Reformed Dutch Church, True.—A sect resulting from the secession of a party led by Rev. Sol Froeligh, in 1822. They held that the Reformed Dutch Church had become erroneous in doctrine, lax in discipline and corrupt in practice. During recent years the sect has gradually dwindled away although it is still in existence.

Reformed Episcopal Church.—Founded in 1873 as a church of the reformation, or, as a protest against what it termed the errors in the position and practice of the Protestant Episcopal Church.

Reformed German Church.—That portion of the Protestant church which, being unable to embrace either the teaching of Luther or of Zwingli endorsed instead the Melancthonian compromise.

Reformed Presbyterian Church.—Otherwise known as Cameronians. A sect founded in the 17th century as a protest against what its members regarded as the "unworthy compromise" of the Established Church.

Remonstrants.—A title applied to the Arminians for the reason that they had called their creed, adopted in 1610, "The Remonstrance."

Relief Synod.—A body of Scotch dissenters whose secession was the result of their opposition to the existing system of patronage.

Restorationists.—A small sect the beliefs of which may be designated as Universalism in a modified form.

Ritualists.—Another designation for High Churchmen.

Roman Catholic Church.—That body of Christians who look to the Holy See for direction in spiritual things. (See ROMAN CATHOLIC CHURCH.)

Russian Orthodox Church.—The national Church of Russia. It differs in belief but slightly from that of the Roman Catholic Church, from which it separated about 1,000 years ago.

Ruthenians.—The members of the Ruthenian Church

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are converts and the descendants of converts from the Russian Church who now maintain obedience to the Pope in spite of the fact that they have never altered their ancient rites and discipline and still use the Greek liturgy, which they have translated into Old Slavonic.

Sabbatarians.—Those who insist upon the strict observance of the Sabbath as a tenet binding upon all Christians.

Sabbatians.—A 4th century sect the members of which adopted the Quartodeciman rule. Extinct.

Salvation Army.—A quasi-military organization formed to promote the revival of religion among the masses. It was organized in England, about 1865, by William Booth, a Methodist evangelist. At that time it was known as the Christian Mission, and it retained the title until 1878, when it was changed to that of the Salvation Army. Its theological position is thoroughly evangelical.

Samokrischtschins.—A name which signifies "self-baptizers," and which as applied to a sect of Russian Christians, indicates its theological peculiarity.

Sandemanians.—A denomination founded in the 17th century by Robert Sandeman, a disciple of John Glas. Its members maintain a community of goods; abstain from blood meats and from things strangled, and participate in love feasts and a weekly communion.

Satanists.—The members of a strange sect which worships and prays to Satan not only because of his present power to do evil, but on account of his future power to do good.

Schwenckfeldians.—A sect of German anti-sacramentalists founded at the time of the Reformation by Casper Schwenckfeld.

Scottish Baptists.—A sect which differs from other Baptists only by being more Congregational in government and having a somewhat stricter form in discipline.

Scottish Kirk.—The Established Presbyterian Church of Scotland, which, founded on the ruins of the ancient Scottish Church, in the 16th century was adopted as the National Establishment by act of Parliament.

Second Adventists.—(See ADVENTISM and MILLENNARIANISM.)

Secularists.—The term Secularist is most generally applied to the members of that school of skepticism which holds that man should devote his attention only to the duties and interests of this world.

Seleucians.—Followers of Seleucus, who rejected baptism by water and who taught that there would be no resurrection of the body. Extinct.

Seventh-day Adventists.—The most primitive form of Adventism, its members practising many of the ancient Christian rites. (See ADVENTISM.)

Seventh-Day Baptists.—A sect which differs from other Baptists chiefly in the observance of Saturday, or the seventh day of the week, as its day for rest and worship.

Shafities.—A Mohammedan sect, one of the four branches into which the orthodox sect of Sunnites has been divided.

Shakers.—A sect of American millenarians founded in 1776 by Ann Lee. Although it does not impose celibacy as a necessary rule of life, married couples are not permitted to live together in its communities.

Shaktas.—A Hindu sect, the members of which worship the divine power under its female representation.

Shiaha.—A Mohammedan sect which claims to be the one orthodox branch of the religion because they accept Ali, the first cousin of Mohammed, as the successor to the prophet, rejecting the other caliphs who are accepted by the Sunnites.

Shiites.—One of the two great divisions of Mohammedanism. Its doctrines are directly contrary to those of the orthodox sect, the Sunnites.

Shintoism.—The state religion of Japan. It teaches the existence of both good and evil gods.

Sikhs.—A sect founded in India, about 1500, upon principles of monotheism and human brotherhood.

Six-Principle Baptists.—The oldest sect of American Baptists. Its doctrines are founded upon the "six principles" mentioned in the first three verses of the sixth chapter of the Epistle to the Hebrews: (1) Repentance from dead works; (2) faith toward God; (3) baptism; (4) laying on of hands; (5) resurrection of the dead, and (6) eternal judgment.

Skeptists.—A fanatical sect of Russians. Its members practise severe penances, including, it is said, self-mutilation.

Smartas.—One of the three great divisions of the Hindu religion.

Society of Friends.—(See FRIENDS, SOCIETY OF.)

Socinians.—The followers of Socinius, who denied the divinity of Christ and the atonement, who rejected the sacraments and the authority of the Scriptures, and who held that the soul of man was born pure.

Southcottians.—The followers of Joanna Southcott,

who professed to be the inspired woman of Revelation, who was predestined to give birth to the new Messiah. Although she died of dropsy ten days after the date on which, as she had predicted, this event was to occur, her disciples maintained their faith in her supernatural gifts, and the sect still exists in small numbers in England.

Spiritualism.—A religious body composed of those who believe that it is possible for man to hold communication with the spirits of the departed.

Starovertsi.—A designation applied to those who refused to participate in the ecclesiastical reforms introduced in the Russian Church in the 17th century. The name signifies the "men of the ancient faith."

Sunnites.—The name applied to the orthodox Mohammedans who constitute the largest sect of the Moslem world. Its members accept the books of Sunna, said to be the verbal utterances of Mohammed, as well as the Koran, as the sources of doctrine. (See SUNNITES.)

Swedenborgians.—Otherwise known as the Church of the New Jerusalem. A religious system promulgated by Emmanuel Swedenborg, who taught that the last judgment had taken place in the year 1757, when the "Old Church," or Christianity had given place to the new dispensation as represented by the "New Church" of Swedenborg.

Syrian Church.—A religious body still under obedience to the Pope. Its members continue to maintain the ancient Syriac rites, which are common alike to the Jacobites and themselves.

Taborites.—The members of one of the most extreme parties of Hussites.

Taoism.—The materialistic religion of China.

Theists.—Believers in a personal Creator and Divinity, however conceived as related to man. The term is used as contrasted with Deists; Deism being the belief in a divine principle, not a personality.

Theosophists.—Those mystics who affirm that they are admitted to a knowledge of the mysteries of being, on the side of nature as well as upon that of religion, by means of an internal and supernatural illumination. One of the most modern applications of the word is as a designation for the followers of Mme. Blavatsky.

Traskites.—An early name for the Sabbatarian puritans.

Tübingen School.—A name applied to a certain rationalistic school of philosophy, the members of which questioned the credibility, integrity, and reliability of the New Testament.

Ultramontanists.—From a Roman Catholic point of view this name is applied to those who believe that the Pope is supreme ruler over every part of the Christian Church and of every sovereign of earth.

Unitarian.—A name applied to those who deny the distinction of persons in the Trinity and who hold that they in themselves only hold, in its true sense, the Unity of God.

United Brethren.—Otherwise known as United Brethren in Christ. A sect whose present doctrinal position is quite similar to that of the Moravians. Although never officially instituted it grew out of the attempt of William Otterbein to found a church that would unite the various Presbyterian sects as one body of Christians.

United Presbyterians.—A body composed of two sects of Scotch dissenters, the Associated and the Relief synods.

Universalists.—Those who believe in the ultimate salvation of all mankind.

Utilitarian.—A designation applied to those who hold that man's actions derive their character, in a moral sense, from their consequences.

Vamamargis.—The name applied to those persons who, in Hinduism, worship the female side of the dual nature of Vishnu.

Volunteers of America.—An offshoot from the Salvation Army resulting from a misunderstanding between the leaders of the two bodies. As in the Salvation Army both sexes participate in its meetings, and, like the older body, while it has no formulated creed, it is thoroughly evangelical.

Wahhabees.—Followers of Abd-el-Wahhab, a Mohammedan reformer of the 18th century. They strenuously oppose all practices not absolutely sanctioned by the Koran.

Waldensians.—A reforming body of Christians, the members of which participated in the Reformation. A Waldensian church now existent in Italy numbers more than 20,000 members.

Waterlanders.—A sect of Mennonites, similar in doctrine but less rigid in discipline than the main body.

Wilburites.—A branch of the Society of Friends who followed John Wilbur in his protests against the actions of the Society in abandoning its original principles.

Wilkinsonians.—A 19th century American sect the

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members of which accepted the statements of Jemima Wilkinson, who asserted that she was divinely inspired, having been raised from the dead.

Yezedees.—An ancient sect of unknown origin. Its members form a tribe of individual nationality located in the neighborhood of Mosul. They not only believe in God but also in Satan, whom they recognize as the chief of the angelic hosts. Admitting that he is suffering punishment now, they believe that he will eventually be restored to his originally high station. As the result, like the Satanists, they believe that it is right for man to pray to him.

Zanzalians.—A designation applied to the Jacobites of the East.

Zoarites.—The name applied to a sect of American Lutherans.

Zoharites.—A modern Jewish sect which takes its name from the Kabbalistic book of Zohar, which is held in great veneration.

Zoroastrians.—See PARSEES.

J. R. MEADER,
Editor (*American Almanac*.)

Religious Societies. See ORDERS, RELIGIOUS.

Relly, James, Welsh Universalist clergyman: b. Jeffreston, Pembrokeshire, Wales, about 1722; d. London, England, 25 April 1778. He was converted by George Whitefield in 1741 and became one of his preachers, but after several years became convinced of the truth of Universalism and broke with Whitefield. He settled in London in 1761 and though his preaching met with little success yet in 1770 he converted to his faith John Murray (q.v.), the founder of Universalism in United States.

Remainder is defined in law as an estate which commences after the determination of another estate in the same property, which has previously been limited by the same conveyance. A remainder becomes vested whenever the preceding estate is limited so as to determine on an event which must certainly happen. It is the present right of one to the future enjoyment of an estate, which right takes effect on the determination of the preceding estate. Contingent estates usually give rise to considerable doubt. The intention expressed in the instrument by which the contingent estate is created, governs. Contingent remainders are defined by statute in some States.

Rembang, rēm-bāng', Java, a busy town on the north coast, west of the river Rembang, and 60 miles west-northwest of Samarang. Its well-protected harbor is one of the best in the island. It has a good trade in ship-timber and in ship-building, and near it are valuable salt-pans. Pop. 11,000.

Rembrandt, rēm'brānt or -brānt (full name written REMBRANDT HARMENSZ VAN RIJN or RYN), Dutch painter and etcher: b. Leyden 15 July 1607; d. Amsterdam 8 Oct. 1669. He was the son of a miller settled in Leyden; and an early shown disposition toward the life of an artist caused him to be taken from the Latin School at an early age and put into the studio of a Leyden artist who took pupils. In 1622 he was sent to a studio in Amsterdam. In 1623 he seems to have been working as an artist and there is a signed and dated picture of 'Saint Paul in Prison' in the Stuttgart Gallery, which is his earliest piece with an ascertained date. By 1630 he was settled in Amsterdam, and in 1634 married Saskia van Ulenburgh, who lived with him only eight years, leaving one son, Titus. Saskia had property; and her death caused confusion in Rembrandt's affairs because of her will leaving all of this property to Titus, with only a life interest to her husband, while in the mean-

time Rembrandt's affairs had been in a bad condition. In 1656 he was finally sold out as a bankrupt. It is not perfectly known why the very prosperous painter who, in his early manhood, had a great deal of work to do as a portrait painter (always a profitable branch of the art), and whose etchings sold remarkably well, should have become so straitened in his circumstances. It is known that he bought very freely, surrounding himself with works of art of all kinds, of which he was a constant and diligent student, and by means of which he gave himself that knowledge of the world which he did not obtain from travel, as it appears that he never crossed the frontiers of the United Provinces. It is also asserted that a certain change in popular taste left him at one side while it followed men whom we now deem greatly his inferiors in artistic power. He had many pupils and many assistants, and even the interruptions caused by death and by loss of fortune do not seem to have checked the great production of his work, for between the time of his bankruptcy and the time of his death, 13 years later, he was as busily engaged and his work was fully as important as at any former time. The mention of a few works of art with their dates in the course of this article illustrates this fact sufficiently well.

At a very early date Rembrandt's style as a painter was fixed. It is extremely original, founded on the work of no other artist of any school, based upon a strong perception of the beauty and value of pure light and shade in nature and in art. In one sense he was a great colorist, namely in that he conceived a painting as strictly the result of a disposition and combination of the hues and tints, treating all his work with as complete a color-scheme as that used by the great Venetians. There is this peculiarity, however, that Rembrandt's coloring is sombre, and reaches its highest achievement in combinations of browns and grays with but few passages of primary color or of those hues which approximate to primary color. A blue sash may appear in a portrait, and its effect of pure, bright color may be led up to and assisted by the glimmer of steel and the warm yellowish-brown of a buff coat; but as a general thing these effects are not his happiest achievements as we see the pictures now, and those are the most delightful to us in which he departs the least from his accustomed gravity of tone. There is a certain disappearing of the subject in blackness which is very disagreeable to many lovers of painting; and it is hard to form a conception of how far this has been the result of time producing changes in the pigments. Meanwhile the effect of a brilliantly modeled head coming to light from a profoundly gloomy background and helped by the painting of costume similarly relieved by light colors upon darkness, is very pleasing to many students; and apart from his obviously surpassing ability, Rembrandt is a delightful painter to many ardent lovers of the art of painting. To painters by profession Rembrandt must always be one of the men whose work commands the highest respect.

His power of characterization is not confined to painting, and his small etchings drawn upon copper in a few straggling lines have as much of it, according to their subject, as the

largest pictures. This power of characterization lifts him almost out of the category of the painters of his period. When he has character to express, either of an individual or of a race of men, he does it with a touch and an evidence of thought entirely his own. It may sometimes take a disagreeable, even an ignominious appearance, and his drawing in a given case may not be dignified or refined or even truthful; while yet the significance of the statement he wishes to make remains uniformly distinct and positive.

Among his most important paintings are the 'Saint Paul in Prison,' in the Stuttgart Gallery, signed and dated 1627; the portrait of a man at Windsor Castle, signed and dated 1631; the portrait of his brother in the Berlin Museum, that of himself in Buckingham Palace, and that of an old woman in the Hermitage collection near Saint Petersburg; 'The Supper at Emmaus,' in the Louvre; and 'The Lesson in Anatomy,' at The Hague. There are two magnificent portrait groups, one of his middle life and one of his more advanced age; 'The Night Watch,' in the Amsterdam Museum, signed and dated 1642, and 'The Syndics of the Clothmakers' Company,' in the Amsterdam Museum, signed and dated 1661.

Of his etchings the number is so very great and the enthusiasm which they have excited among great classes of collectors and students during the 19th century is so intense, that it is very hard to name even a few characteristic specimens. The prices which they fetch at auction or at private sale are enormous (several thousands of dollars in many cases), though price is not always proportionate to merit, as rarity has much to do with this detail. Thus the famous 'Three Trees' (1643), of which a fine copy is worth as much money as a large oil painting by a modern artist, and the wonderful portrait of the 'Burgomaster Six' are not necessarily as much better than other and less costly prints as their price would indicate. Their faultless work, however, is the main consideration, and the portrait of Six must always be of extreme value when in fine condition, because the closely worked etching has caused the plate to suffer from use—there can never have been more than 40 or 50 impressions of great brilliancy. During his life and during the 18th century the so-called Hundred Guilder print, 'Christ Healing the Sick,' was the most famous; and since that time the etching, slight and but little worked over, 'The Death of the Virgin' (1639), is one of the most admired by artists of all Rembrandt's work in black and white; the wonderful portrait of the 'Goldweigher' (1639), that of the preacher, Uijtenbogaert (1635), the famous Dr. Faustus, dated 1648, and several of the landscapes, especially the 'Cottage with the Great Tree,' and the magnificent 'Omval,' dated 1645, are all etchings which are unsurpassable even among Rembrandt's own works.

The most complete book on Rembrandt, that of C. Vosmaer, 'Rembrandt, sa Vie et ses Œuvres' (1877), has furnished most writers since that time with their facts. A more recent work of great extent and thoroughness is that by Emile Michel, translated into English as 'Rembrandt, his Life, his Work, his Time' (London, 1894). This book is elaborately illus-

trated. Small biographies by Knackfuss (1899), Malcolm Bell (1899), Neumann (1900), some of them well imagined, are contained in the different series of Artists' Lives. The etchings form a continual study, and besides the famous work of Bartsch (1797), which is continually referred to, there have been works by Charles Blanc (1880) and Dutuit. His complete etched work has been reproduced in admirable photographure by Armand-Durand. The English etcher and student of etchings, Sir Francis Seymour Haden, has published a small book on Rembrandt's etchings, 'The Etched Work of Rembrandt' (1879-80), in which there is a careful investigation of the authenticity of some which may be thought to be by students or imitators.

RUSSELL STURGIS.

Remedios, rā-mā'thē-ōs, or **San Juan de Los Remedios**, sän hoo-än' dé lös rā-mā'thē-ōs, town, Santa Clara province, 32 miles east of the town of Santa Clara. It is four miles from the north coast, but is connected with its port, Caibarien, by rail, and also with the important towns of the island to the west. It is in a fertile region and carries on a good trade. Pop. about 7,000.

Remensnyder, rēm'en-sni'dér, **Junius Benjamin**, American Lutheran clergyman: b. Staunton, Va., 24 Feb. 1843. He was graduated from Pennsylvania College, Gettysburg, in 1861 and from its theological department in 1865. He served in the Union army in 1862-3, was ordained in 1865 and has held important pastorates at Philadelphia, Savannah, and New York, and originated the movement which resulted in the adoption of a common service ritual in all American Lutheran churches. He has published: 'Heavenward' (1874); 'Doom Eternal' (1880); 'Six Days of Creation' (1886); 'Lutheran Manual' (1892); etc.

Remenyi, rēm'ān-yē, **Edouard**, Hungarian violinist: b. Heves 1830; d. San Francisco, Cal., 15 May 1898. He studied violin at Vienna under Joseph Böhm. For his part in the insurrection against Austria in 1848 he was obliged to flee from Hungary. He came to the United States in 1849, but returned to Europe a few years later and in 1854 was appointed solo violinist to Queen Victoria. He returned to Hungary in 1860 under the amnesty, and attained great fame. Thenceforward he made repeated tours in Europe and returned to the United States in 1878, where he spent much time until his death. He possessed a high technical mastery of his instrument, but was often betrayed into exaggerations that marred the artistic effects of his playing.

Remey, rā'mī, **George Collier**, American naval officer: b. Burlington, Iowa, 10 Aug. 1841. He was graduated from the United States Naval Academy in 1859 and entered the navy and served with distinction on the Union side during the Civil War. When the war with Spain broke out he was placed in command of the naval base at Key West, Fla., and subsequently became commandant of the navy yard at Portsmouth, N. H. He was promoted rear-admiral in 1898, and in 1900 was given command of the Asiatic Station at Yokohama, and in this capacity directing the operations of the United States naval forces in China. He was retired in August 1903.



From the original painting by himself.

HARMENSZ VAN RIJN REMBRANDT

REMIGIUS — REMSEN

Remigius, rě-mīj'ŭs, **Saint**, the great apostle of the French nation: b. Laon 438; d. Rheims 13 Jan. 533. He was appointed bishop of Rheims in 459. He it was who baptized Clovis, the founder of the French monarchy, who had been converted to Christianity chiefly through the influence of his queen, Clothilde. The ceremony took place amid imposing surroundings on Christmas Day, 496. Through the example of the king and the untiring exertions of Remigius almost the whole of Gaul was Christianized in the lifetime of the latter. Consult: Migne, 'Patrologia Latina,' Vol. LXV. (which contains some of the bishop's letters); Aubert, 'Vie de Saint Remi' (1849).

Remington, Frederic, American artist: b. Canton, N. Y., 4 Oct. 1861. He studied at the Yale Art School and the Art Students' League, New York, and later went west where, as cowboy and stockman on a ranch, he gathered the material that has made him a success in scenes of frontier life. He has contributed frequently to the leading magazines and periodicals scenes of western military and Indian life, and also events of the Cuban War of 1897-8. Few illustrators draw the horse with so much character and life-likeness. He has produced several sculptures such as 'The Broncho Buster' and 'The Wounded Bunkie.' As author and illustrator he has produced 'Pony Tracks' (1895); 'Crooked Trails' (1898); 'Frontier Sketches'; and a novel, 'John Ermine of the Yellowstone' (1902).

Remington, Philo, American inventor: b. Litchfield, N. Y., 31 Oct. 1816; d. Silver Springs, Fla., 5 April 1889. He entered the small-arms factory of his father at Ilion, N. Y., and for 25 years was superintendent of the mechanical department. The perfecting of the Remington breech-loading rifles and of the Remington typewriter was mainly due to him. In 1886 he withdrew into private life and in that year Wyckoff, Seamans & Benedict bought out the Remington interest in the typewriter, and an assignment having been made, took charge of the Ilion plant. In 1888 the main plant passed to Hartley & Graham, who operated it as the Remington Arms Company.

Remington Rifle. See SMALL ARMS.

Remittent Fever. See JUNGLE-FEVER; MALARIA.

Remonstrants, those members of the Reformed Church in Holland who, in the year 1609, after the death of Jacobus Arminius, continued to adhere to his doctrines, and in 1610 presented to the States of Holland a remonstrance in which they defend the grounds of their dissent from the official creeds of the Reformed Church: thereafter they were styled Remonstrants, and they are still represented in Holland by a small but scholarly and liberal sect. See ARMINIANS; RELIGIOUS SECTS.

Rem'ora, or **Sucking-fish**, a popular name for any species of the family *Echineididae* and order *Discocephali*. The top of the head is provided with a peculiar sucking disk, a modification of the spinous dorsal fin, composed of a series of plates arranged transversely, by means of which they attach themselves to moving objects and thus supplement their powers of locomotion. On the coast of Zanzibar and elsewhere they are used in catching other fishes and

turtles, the remora being secured by a line fixed to the tail, and being sent in pursuit of the turtles, etc., to which it attaches itself by means of its sucker. The ancients believed in the remora's power of arresting and detaining ships in full sail through their suction powers; and Antony's galley at the battle of Actium was said to have been fixed by a remora, which defied the efforts of several hundreds of men to free the vessel.

The remoras are a group of oceanic fishes occupying a rather isolated position among the spiny-rayed *Teleostomi*. Five genera and eight species have been recorded from North American waters. Some of them appear to confine their attentions to particular species of large fishes, as the spear-fish, dolphins, etc.; others are less particular. The common species on the Atlantic coast of the United States are the shark-sucker (*Echeneis naucrates*), very frequently found adhering to large sharks as well as to other fishes; *Remora brachyptera*, the sword-fish remora; and *Remora remora*, a species widely distributed in warm seas. They are not utilized for food nor for any other purpose in this country.

Remscheid, rěm'shit, Prussia, Rhine province; a manufacturing centre. Its chief articles of trade are cutlery and iron wares, besides machinery, tools, silk, etc.

Rem'sen, Ira, American chemist and educator: b. New York 10 Feb. 1846. He studied at the College of the City of New York, was graduated in 1867 from the medical department of Columbia, pursued chemical courses at Munich and Göttingen, and in 1870-2 was assistant to Professor Rudolph Fittig in the chemical laboratory of the University of Tübingen. In 1872-6 he was professor of chemistry and physics in Williams College, and in 1876, upon the organization of the Johns Hopkins University, was made professor of chemistry in the new institution. He formed its chemical department and has continued to direct the numerous researches of the Johns Hopkins laboratory, the facilities of which are not excelled in the United States. Despite the large amount of executive work devolving upon him in connection with his chair, he found opportunity for considerable original investigation, including that in connection with the oxidation of aromatic substitution products, the sulphides, double halides, and the decomposition of diazo compounds by alcohol. In 1881 he made a study for the city council of a peculiar condition of Boston water, which he found due to a growth of fresh-water sponge in one of the artificial lakes from which the supply was derived. He also conducted for the National Board of Health special researches in various subjects, among them 'Organic Matter in the Air' and 'The Contamination of Air in Rooms Heated by Hot-Air Furnaces or by Cast-Iron Stoves.' He was made vice-president of the university, and frequently, in the absence of the president, Dr. Daniel Coit Gilman (q.v.), acted as president. In June 1901 he was chosen president upon the resignation of Dr. Gilman. In 1873 he was elected to the American Association, in 1875 made fellow, and in 1879 president of the chemical section, and in 1902 president of the association. He became a member of the National Academy of Sciences in 1882, and was at one time president of the American Chemical

REMUS — RENAISSANCE

Society. He founded in 1879, and has since edited, the 'American Chemical Journal.' Among his text-books are: 'The Principles of Theoretical Chemistry' (1877); 'Introduction to the Study of the Compounds of Carbon, or Organic Chemistry' (1885); 'Introduction to the Study of Chemistry' (1886); 'The Elements of Chemistry' (1887); 'A Laboratory Manual' (1889); and 'Chemical Experiments' (1895).

Remus, rê'müs, in the fabulous history of Rome, the twin brother of the founder of the city, Romulus, who in a quarrel slew him.

Remus, Uncle, a well-known negro character invented by Joel Chandler Harris (q.v.) and introduced to his readers in 'Uncle Remus: His Songs and Sayings' (1880). Uncle Remus, an aged plantation African, is used as the mouth-piece of quaint folk-lore tales current among the blacks of the South and detailing in picturesque and amusing fashion the adventures of Bre'r Rabbit, Bre'r Fox, and other animals. The stories, interlarded with considerable homely philosophy, were gathered with much care by the author, and awakened among students an interest in that domain of the beast-fable.

Rémusat, râ-mü-zâ, Charles François Marie, COMTE DE, French politician and man of letters, son of the Comtesse de Rémusat (q.v.): b. Paris 13 March 1797; d. there 6 June 1875. He was educated at the Lycée Napoleon and entered life as a journalist and lawyer. He was a member of the Chamber of Deputies 1830-48, and in 1848-9 of the constituent and legislative assemblies, in which he voted with the friends of order. From March to October 1840 he was minister of the interior, and in 1871-3 minister of foreign affairs. He began public life as a Liberal, but ended it as a Conservative. During the Second Empire he lived in retirement, devoting himself chiefly to literary pursuits. His works include: 'L'Angleterre au XVIII. Siècle' (1856); 'Bacon' (1857); 'Lord Herbert of Cherbury' (1874); 'Histoire de la Philosophie en Angleterre depuis Bacon jusqu'à Locke' (1875); 'Abélard' (1845); 'Essais de Philosophie' (1842); etc.

Rémusat, Claire Elizabeth Jeanne Gravier de Vergennes, COMTESSE DE: b. Paris 5 Jan. 1780; d. 16 Dec. 1821. She was married to Comte Auguste Laurent de Rémusat, Napoleon's chamberlain, and her position made her thoroughly acquainted with the life of Napoleon's court. Her 'Essai sur l'Education des Femmes,' published 1824, received an academic *couronne*, and her 'Mémoires,' published in 1879-80, are particularly valuable for the light they throw on the court of the First Empire.

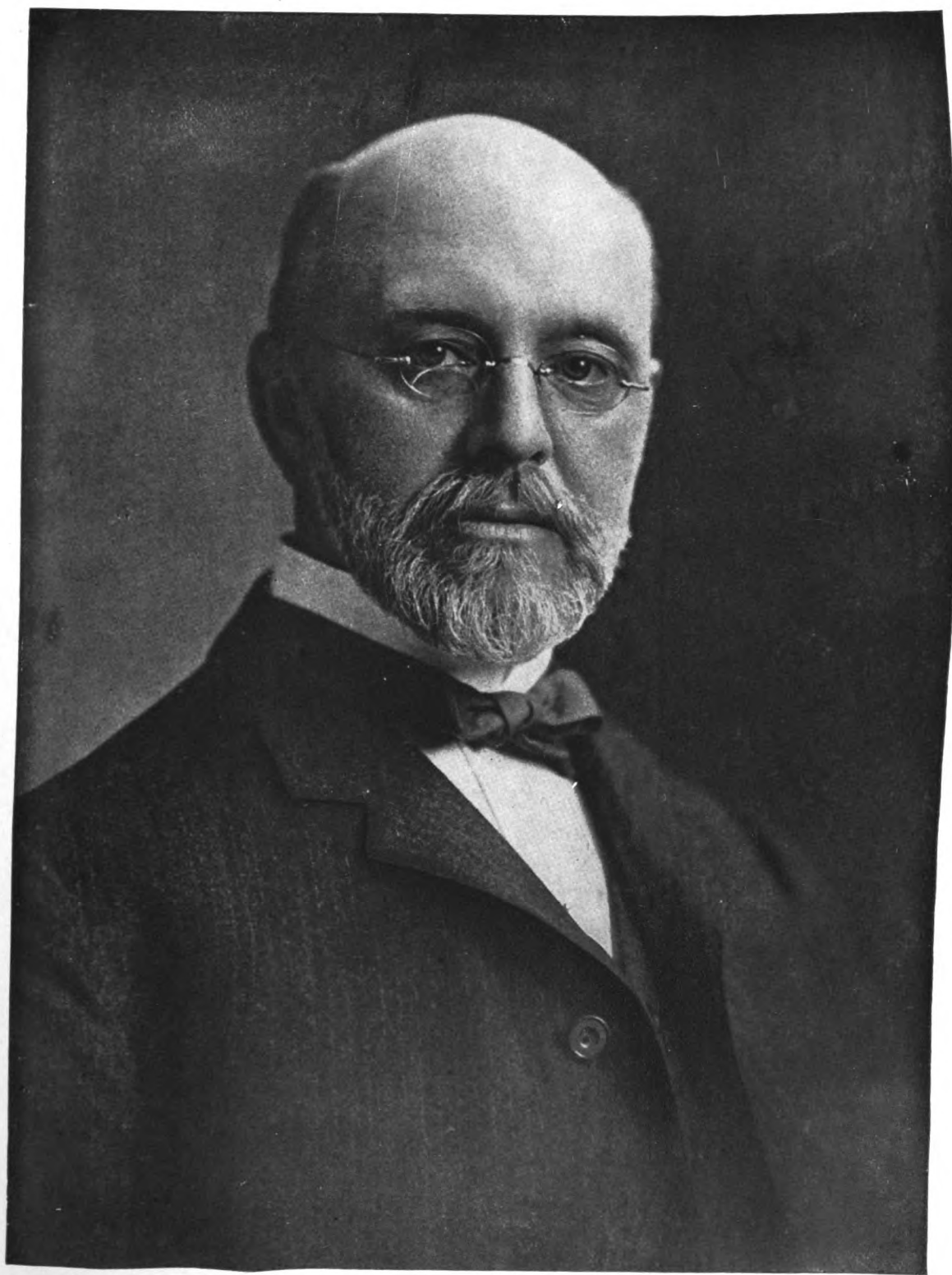
Rémusat, Jean Pierre Abel, French Orientalist: b. Paris 5 Sept. 1788; d. there 3 June 1832. He devoted himself to the study of Oriental languages, particularly Chinese, while pursuing a course in medicine, and in 1811 published 'Essai sur la Langue et la Littérature chinoises.' He received his degree as a physician in 1814 and entered one of the military hospitals, but in that year accepted the chair of Chinese which had been established for him at the Collège de France. He was admitted to the Academy of Inscriptions in 1816 and in 1818, after Visconti's death, became editor of the 'Journal des Savants.' He was one of the founders of the Société Asiatique in Paris. His

works include: 'Livre des Récompenses et des Peines' (1816); 'L'invariable Milieu' of Tsz-tse' (1817); 'Eléments de la Grammaire chinoise' (1822); 'Mémoire sur la Vie et les Opinions de Lao-tse' (1823); 'Recherches sur les Langues tartares' (1829); etc. Consult Silvestre de Sacy, 'Notice sur la Vie et les Ouvrages de Rémusat' (1834).

Remy, Saint. See REMIGIUS, SAINT.

Renaissance, rê-nâ-sâns or rê-nâ'sans, a movement in learning, science, literature or art, or in all of them, in which it is thought that there is a revival of an ancient spirit and of ancient methods, or even a decided advance in intelligence without traceable imitation. The name is given especially to several movements in European history, all more or less abortive; but most of all to the great movement which began in Italy about 1300 A.D. This movement, called by the Italians the *Risorgimento*, consisted at first, so far as conscious effort was concerned, in the collecting of Latin manuscripts of the classical authors, and the study of them. It is noticeable, however, that this purely scholarly movement was accompanied by a general intellectual advance, of which, indeed, some evidence is to be seen in different parts of Europe, at least a half-century earlier than the time fixed above. Thus in England the monk, Roger Bacon, who died in 1294, had done a great deal of needed work in asserting the necessity of studying nature directly by observation and in a sense by experiment, disregarding in the main the opinions of churchmen, schoolmen or professors in the universities. Marco Polo, traveling with his father and uncle, at the close of the 13th century, throughout a large part of Asia, visiting China and Japan, published in his account of his voyages that which had not been guessed before about the Far East. The third Crusade, under Philip Augustus of France and Richard I. of England, had closed in 1192; and the fourth Crusade with the capture of Constantinople by the Latins ended with 1204, while the later expeditions of John of Brienne and of Louis IX. all ended by 1270: and while these expeditions failed utterly in their main object, they spread through Europe the knowledge or other races, other peoples and other scholarships than that possessed by the West. The enlightened emperor Frederick II., who died in 1250, was an enthusiastic advocate of classical studies.

So in the arts of design, the wonderful achievements of the Gothic architects, though wholly mediæval in origin, were yet a step toward modern times in the general application of sound principles of construction, studied, indeed, largely by the rule of thumb and empirically, but still affecting favorably large numbers of workmen who were kept constantly employed on important structures. All the fine arts were marked in the 13th century by a rapid and on the whole permanent gain, for sculpture in connection with the great cathedrals was developed with extraordinary rapidity and reached great excellence in truth to nature and in decorative effect: and excellent designs in color grew with the growing art of decorative glass in huge windows, while all the subsidiary arts in metal, leather, and the like were



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being pushed intelligently and with vigor. Moreover, in pure literature, the works of the French poets of the South and at a later time of the Centre, tended toward a larger development in poetry and prose.

Throughout the north of Europe this progress was checked in the 14th century, partly by the ruinous wars which were waged in France by English kings finding means to divide the great nobility of northwestern Europe and to retard the growth of comfort and intelligence for nearly a century. And this fact allowed the leadership to pass to Italy. Thus in 1340, when the Hundred Years' war began in the claim asserted by Edward III. of England to the French crown, Petrarch was 36 years old and in the middle of his great labors, and his friend, Boccaccio, was following him close. These are the men who are the most famous in the early pursuit of classical learning, but there were associated with them men who were less known as original writers and whose names are therefore less celebrated, who yet did much of the heavy work of collecting and studying manuscript. The death of those two men in 1374 and 1375 may be thought to close the first epoch of the *Risorgimento*—for by this name it would be better to designate the purely Italian movement which continued for three quarters of a century.

It is to be remembered that there was still nearly a century to elapse before the general introduction of printing. The serious work done between 1340 and 1440 was done by the copying and deciphering of manuscripts, and there were no means of producing the manuscripts as cheaply and in such abundance as they were produced in the palmy days of the imperial Roman system. Then the wealthy amateur might have a number of slaves engaged in copying and mounting manuscripts, and these must have been nearly as cheap as printed books were until very recent times; but in the 14th century there was no traditional method of transcribing books other than as known to the monks of the scriptoria of monasteries, and the crabbed hand used by these transcribers must have retarded study, while at the same time no accuracy could be expected from unscholarly men under no strict and watchful supervision. These were the reasons for the marked slowness of the growth, for after the death of the two great students named above there was reaction and languor.

The fine arts were influenced at first by no study of manuscripts, but by the direct observation of Græco-Roman remains in Italy. Thus Nicolà Pisano, who died in 1278, shows in his work the effects of his own observation of Roman sarcophagi and other reliefs, and Giotto, born two years before Pisano's death, shows also, in his readiness to break away from the mediæval designs and to create for himself new dispositions of personages in sacred and legendary painting, a freedom which can hardly have come altogether from his own observation. These artists are not to be considered as men of the new movement; they were rather the last men of the mediæval epoch; and yet they were as truly the precursors of the *Risorgimento*. The work of Giovanni Pisano (about 1240-1320) and Andrea Pisano, born in 1270 but living on till 1345, marks in a still more positive fashion the beginning of a strong classi-

cal influence over the arts of design. Most influential of all was Orcagna, properly Andrea di Cione, whose active life may be set down as lasting from 1340 to 1376, and who built one of the most important buildings of the 14th century, the shrine in the church of Orsanmichele at Florence: a marvel of combined sculpture and color-inlay in an architectural composition. So, if we are considering the introduction and growth of neoclassic art at a time when all the important churches of Italy were built in that highly decorative, but insincere, misunderstood and inconsistent Italian-Gothic of the 14th century, the noble portico at Florence, called the Loggia dei Lanzi, is to be cited. It was built about 1375-80, and the designer, while he used something of the mediæval vaulting system, gave to the building an entirely non-Gothic aspect by using round arches of great span without buttresses, depending, for the security of each abutment, upon the heavy load piled upon it. The building is designed absolutely without reference to any classical Roman structure or to the Roman system of building in any way, and it is on this account closely in harmony with the artistic work done during the same epoch in painting and in sculpture. All the arts of design were at this time newly inspired by the great perfection of classical remains, and under this new inspiration turned away from the mediæval system, which, indeed, had never obtained a strong hold upon the Italians. Thus in the matter of fine art is the true *Risorgimento* a splendid epoch of early enthusiasm, which is seen prolonged into the next century and reaching its most glorious culmination in the cupola of the Cathedral of Florence, which was the work of Filippo Brunelleschi, born in 1377, and himself a sculptor of renown. He had studied in Rome and, according to the tradition, was especially interested in the cupola of the Pantheon, and yet when the managers of the cathedral employed him to roof the open central octagon of their great church, he built nothing in the least degree resembling any classical dome, but chose an outline nearly like that of a pointed arch, an octagonal plan, and a soaring cupola which dominates the whole structure, and is admirably adapted to its general Gothic style of design. This same Brunelleschi was desirous, however, to introduce the classical orders, and his important work, the chapel of the Pazzi connected with the church of Santa Croce in Florence, is the first neoclassic building.

Of nearly the same epoch as this of the architectural Rebirth is to be put down the complete triumph in sculpture of that semi-classical school which indeed used the science and the skilled conventional modeling of the Græco-Roman masters, but never their manner of thought or their artistical conception. Lorenzo Ghiberti (1380-1455) and Donatello (1386-1466) are the strongest men of this period, but Lucca della Robbia, who died about 1482, was in the first place an exquisite and many-sided artist in marble and bronze and was also the introducer of that great system of colored and glazed terra-cotta which is known by his name and which is the most unique and brilliant art of the time. Other sculptors there were, less famous but hardly less exquisite, and of them the chief is perhaps Mino da Fiesole (1400-1486). The painters of

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this time are too numerous to be treated here (see PAINTING); and the special biographies of the artists of the time, especially Fra Angelico (1387-1455), Masaccio (1401-28), Fra Filippo Lippi (1412-68), Mantegna (1431-1506), Sandro Botticelli (1447-1515), Leonardo da Vinci (1452-1519), Raphael (1483-1520).

The beginning of the Renaissance in the North is with the invasion of Italy by Charles VIII. of France, successor of Louis XI. This expedition began in 1494, and within a few years from that time the French nobles who had accompanied him on his march began to return, with their minds full of new ideas as to what was possible in painting and in sculpture of the human form, and also what was to be done in the way of scholarship. Not only nobles, but men of letters, students of the universities, writers, even churchmen to a certain extent, became converted to the idea of a larger and more varied art and one which in their opinion could be based upon classical examples—and this in poetry as well as in architecture, in prose writing as well as in painting.

The discovery of America and the beginning of the great voyages undertaken by the Spanish, Portuguese and French made this second step in the Renaissance (for by this name we should call it from this time on) a thing more general than even the study of literature and art could have made it alone. By this time, too, printing had become common. By 1494 many books had been printed, the Latin letter introduced by the Italian scribes had driven out "Black Letter" for all important printing in the South of Europe, and books, though not yet cheap, were accessible, and were of superior trustworthiness in this—that all the copies of an edition were assuredly alike.

The Renaissance in the North seems to moderns in the main an artistical movement, because, at the close of the 15th century, when peace succeeded devastating war in western Europe, the spread of learning had become so general that it no longer presented the limited nature of a deliberate, studied revival. Thus François Villon (1430-about 1490) presents in his verse and his order of thought a completely modern or non-mediæval aspect, and one who may be called his successor, François Rabelais (1495-about 1553) may be thought to accept the new learning as a thing entirely recognized and within everyone's reach, much as scholars of the 19th century receive whatever their predecessors have left for them without considering the immediate causes of that achievement. But the change in architecture and all the arts of decoration was most visible beginning with the work of Jean Bullant, who flourished about 1540, Jacques Androuet du Cerceau, of about the same epoch, and Philibert Delorme, a very few years later. The question of sculpture in France at this time is a very curious and a somewhat difficult one. There had been, between 1450 and the accession of Francis I., in 1515, a brilliant development of an almost wholly national art in the hands of such able men as Michel Colombe, Jean Perréal, Ligier Richier and others, who indeed show a Flemish influence on the one hand and an ultramontane, or at least a semi-classical influence on the other, but who are certainly French or Burgundian in their main tendencies. These men were busily engaged in creating a school of

sculpture, the natural result of the great Gothic school pushed to greater realism and inspired with profounder knowledge. This school was destroyed by the purely classical influence coming from Italy, and at the same time the buildings of the Chateau of Ecouen (the façade on the court, more especially), those of the new Louvre, of the Palace of Fontainebleau, mark the definite adoption of Roman architecture as the standard toward which all efforts should tend. This classical tendency grew always stronger through the reigns of Francis I. (1515-47) and Henry II. (1547-59), until all art seems to perish together during the miserable religious wars of the years from 1560 to 1600.

The strange result of the Renaissance in the North was that neither painting nor sculpture reached any great achievement from the time that the classical influence was fully established until the middle of the 17th century. There were exceptions, especially in Germany, where the classical influence was less strongly felt—where it came slowly and took but a feeble hold. There the great and thoughtful artist, Albert Dürer, who died in 1528, was succeeded by the more learned and more skilful though not more artistic painter, Hans Holbein the Younger (1497-1543). In like manner there was in France and Germany as well as in the Low Countries a splendid non-classical architecture, which is worthy of study on account of its unique character. The disposition was to build with nearly the old Gothic forms, with the same high roofs, the same free placing of windows, the same disposition of the masses, while the pointed arch and other Gothic details were wholly abandoned, and even certain parts studied rather carefully from Italian examples were introduced. Thus the chateaux on the Loire and other parts of northern France, the famous town houses of what is now Belgium, and the later churches and municipal buildings of Germany and what is now Austria, were built on these lines. The buildings are by no means classical, either in proportion or in detail, neither are they Italian; and yet they are altogether different from what was built as long as the Gothic school held sway.

It has been customary among French writers to date the beginning of the Renaissance in architecture in the very heart of the flamboyant Gothic period; thus a church like that of Saint Riquier, in northern France, Saint Maclou at Rouen in Normandy, and the famous church of Brou at Bourg-en-Bresse in the south of France, are called buildings of the early Renaissance, while at the same time they are unquestionably Gothic in their conception. In this way the not perfectly definite architecture of the northern Renaissance passes on through many interesting developments until in the 17th century it is replaced by the formal work of the reign of Louis XIV. and his contemporaries.

In dealing with England and Scotland it is not usual to speak of the Renaissance at all. There were, of course, students there of the new learning, but the wars of the Roses interfered to check the growth of this, and the interest in the theological struggles of the day seems to have put an end to it altogether. The architecture known as the Elizabethan and that which followed it, known as the Jacobean, stand

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for the Renaissance architecture of England, and this, like the building of the Continent, shows a mixture of the Gothic with the semi-classical element.

An interesting question is that which concerns the close of the Renaissance. It has always been customary for the Italians to see the termination of the *Risorgimento* in the complete victory of the principles which it represents. Obviously it is no longer a "re-arrising" when the end is gained; and therefore the Italians speak of the period as ending with its highest achievement. Michelangelo, who died very old (1564), is the great artist of the very close of the Renaissance. Jacopo Sansovino (died 1570) may be considered even as outside of it and coming later. Titian, Tintoretto, Veronese, and all the great Venetians are hardly ever classed as men of the rebirth. After 1550 the *decadenza* begins: or, at least, the *classicismo* is then well established, and from this the decadence soon follows. So in France it is usual to speak of the Renaissance as closing with the religious wars under the three sons of Henry II., and the art of the time of Henry IV., as of his successors, is outside of it. It is, on the other hand, customary among English writers dealing with the subject of architecture, to speak of all the neoclassic buildings since the 15th century as "Renaissance architecture." In this way even well informed architects and esteemed writers on the subject assume that Saint Peter's Church in Rome, and even Saint Paul's in London, are as much buildings of the Renaissance as the Chateau of Blois or that of Chambord. It would be altogether better for the accuracy of our thinking if this loose way of ascription could be avoided.

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RUSSELL STURGIS.

Renaissance Painting. In central and northern Italy, in the 14th century, the *Giotteschi*, or scholars and imitators of Giotto, soon lost the inspiration and initiative of his art. His great principle of the direct study of nature was much neglected; portraiture, which he had undertaken with imperfect knowledge, became a distinct branch of the art only in the 15th century; and the landscape sentiment was as yet undeveloped. Nevertheless, the seeds of the great awakening of the human intellect, which brought with it a knowledge of antique art and a new intimacy with both Nature and con-

temporary man,—and a consequent development of all the arts,—were germinating; it appeared almost in the first decade of the 15th century in both Italy and the Netherlands. For this Renaissance, the art of painting presented the most favorable means of expression, of rendering the spiritual rather than the merely corporal, the intangible as well as the appearance of reality; and also as an outlet for the individuality which had been so long smothered under formulas and conventions. Rather curiously, this restoration of a long-lost art began, among the Flemish painters, with a suddenness, a completeness, which it was impossible to maintain,—the first great work which figures in the history of this restoration, the great altar-piece in the church of St. Bavon in Ghent, painted by the brothers Huybrecht (Hubert) and Jan van Eyck (q.v.), is an example of completeness of pictorial representation, spiritual and technical, which the survivor of these painters himself was not able to equal in his other works. The mastery seems complete even of the new process of oil painting, which they are generally credited with having first practically employed. (See OIL PAINTING.) Contemporary with this Flemish school of Bruges and Ghent was another of Brabant, with the centre in Brussels, founded by Rogier van der Weyden (q.v.), similar in tendencies. Holland developed an independent school, at Haarlem, the chief of which was Dierick Bouts (d. 1475), whose works show the influence of Van der Weyden, but are marked by somewhat greater luminousness and richness of color and display a knowledge of aerial perspective in landscape. In the paintings of Hans Memlinc (q.v.) of Bruges many of the archaic qualities of his predecessors disappear and are replaced by a greater suavity and feeling for beauty. The influence of the Van Eycks extended down to the end of the 15th century, and Flanders was the seat of a great artistic production, painters and students passing backward and forward between her borders and those of Italy. In France, in the latter part of the century, there was a northern school, and a smaller one in Provence, at the court of René d'Anjou; but the important paintings of this period were nearly all destroyed in the religious wars and the Revolution, and our knowledge of the art is derived chiefly from the miniatures.

The patronage which had been extended to the new art in the Netherlands, by princes, corporations, the Church and private individuals, in the 15th century, was continued in the early years of the 16th. Foremost among the important representatives of the Northern spirit was Quinten Massys (q.v.), or Massijs, of Antwerp (d. in 1530). Jan Gossart (q.v.), called Mabuse, from his native town of Maubeuge in Hainault, on the contrary, after his journey to Italy, adopted many of the characteristics of the Southern painters, which found favor in the eyes of his countrymen. The Dutch painters of this period were numerous; the first to become widely known abroad was Lucas Jakobsz (q.v.), called Lucas van Leyden. The movement toward realism and naturalism was slower in the schools of Germany, the chief of which was that of Cologne; the earliest important work now extant is the large altar-piece, a triptych, known as the *Dombild*, painted by Stephen Lochener (d. 1451). The painters of this school

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substituted for the pictorial or distant backgrounds of the Flemings generally a flat, gold one, and they differed from them also in their retention of the disk-shaped nimbus behind the heads. The Swabian school, chiefly Alsatian, was distinguished by a remarkable artist, a bold innovator, Martin Schongauer (q.v.), the greatest master in Germany of his time, but now best known by his drawings and engravings. The schools of Ulm, Nördlingen and Augsburg were more or less influenced by the Flemish art; two families of painters, the Burckmairs and the Holbeins, combined to raise the fame of Augsburg to the highest degree. In both, an illustrious father was succeeded by a still more illustrious son,—Thoman Burckmair by Hans (q.v.), and Hans Holbein, the elder (q.v.), by his famous son of the same name. The latter, and his brother Ambrosius, are found in Basel in 1515–16. As the most brilliant representative of the German Renaissance, Hans Holbein, the younger (q.v.), rose superior to the limitations of the art of his time, and excelled in all branches. His large mural paintings have all been destroyed; but the votive picture executed for the family of the Burgomaster Meyer in 1526, his portraits—including those of the period of his sojourn in England at the court of Henry VIII.—and his designs and engravings, have been preserved. From the Franconian school, of which Nuremberg was the centre, came the most formidable of his rivals, Albrecht Dürer (q.v.), a pupil of Michael Wolgemut, painter of altar-pieces and of careful portraits, and a skilful wood-engraver. The influence of Nuremberg was diffused over a wide area,—Schleswig, eastern Germany, Bohemia and Poland.

In the north of Europe, the spirit of the Renaissance lagged somewhat behind as compared with its development under the sky of Italy. Climatic conditions, the influence of the Gothic in making angular the forms and the draperies and in diminishing the wall spaces for mural painting, a neglect of the close study of the human body, of proportion, of perspective, a general empiricism in the sciences, the scarcity of examples of antique art, a lack of intelligent and munificent patronage in Germany, even the Reformation itself,—all have been given as partial explanations of this inferiority. Notwithstanding his genius, his earnest researches, and his journey to Italy, Dürer's art remained hampered throughout his life by his mediæval limitations. The Italians, who fully appreciated his work, his imagination and intellectual power, declared that he would have been as great as the greatest of their own artists if they had been born in Florence or Rome and had studied the antique. His great influence over his contemporaries was extended by his engravings. Dürer's chief rival among his contemporaries was Albrecht Altdorfer, the Ratisbon master. Lucas Cranach, the elder, so called from his natal town in Franconia, established a school in Saxony, which survived for some years after his death, although unable to reproduce his strong individuality. In Upper Alsace, the renown of Martin Schongauer was continued by two painters, not natives of the province, Matthias Grünewald and Hans Baldung, the latter, also, betraying strongly the influence of Dürer. The school of Swabia, the most eminent and

the most learned of the German Renaissance, boasted, in addition to the Burckmairs and the Holbeins, of Martin Schaffner, the so-called Master of Ulm, and some other painters. In the Spanish peninsula, at the period of the gradual expulsion of the Moors, the demand for church pictures brought painters from both Italy and Flanders,—from the latter, among others, Jan van Eyck and Rogier van der Weyden.

Among the causes that contributed to the development of the full flower of the Renaissance in Italy,—in addition to those already mentioned,—may be cited the humanistic spirit, derived largely from the enthusiasm arising from the study of the antique, a general aspiration toward the noble and the beautiful, a new ideal of humanity. Contemporary with this was a revival of learning,—more complete than in Germany. The art of painting, however, it was necessary to re-invent; the study of the human figure, the all important subject in the art of the Renaissance, was undertaken scientifically. Church painting remained for a long time the principal feature, and it was greatly favored by the abandonment of the old Gothic type and the division of the field into panels—which permitted of larger wall spaces, of pictures even longer than they were high. These were executed in fresco, the method perfected in the school of Giotto,—*buon fresco*, painting on the last or smooth coating of plaster freshly applied to the wall and while still wet. That which could not be painted upon in the course of the day was cut out and replaced with fresh lime the next morning. In this manner the color becomes an integral part of the wall. The pigments were water colors, usually earths and minerals. Subsequent retouching was necessarily done *al secco*, on the dry wall, and this was generally considered regrettable and somewhat dangerous to the conservation of the painting. Sometimes in the contracts for decorative works we find this retouching insisted upon. Encaustic painting seems to have also been known; tempera and oil painting were usually observed for altar-screens and easel pictures, these being generally panels covered with a thin layer of plaster. For their studies and drawings, the artist worked in monochrome or *gris aille*, called by the Italians painting in *chiaro oscuro*; their colors were ground by their apprentices under their own eyes and selected with great care. The art of painting, the most eloquent expression of the Renaissance, was destined to outstrip the other manifestations, science and letters, if not architecture. Florence remained the chief seat of this art in the 15th century as in the time of Giotto, though her authority was much less than in sculpture; the leaders were Masolino and his pupil Masaccio (q.v.), to the latter is attributed the honor of having invented a new style in painting. Very different from his intelligent naturalism and fine sense of distinction was the sincere and naive piety of the work of the Dominican friar Fra Giovanni da Fiesole (q.v.), called Fra Angelico; and still more so the tasteless "realism" of Paolo di Dono, known as Paolo Uccello (q.v.). Foremost amongst the direct heirs of Masaccio were Fra Filippo Lippi (q.v.), and his son, called Filippino Lippi (q.v.); the paintings of the former betraying new qualities of color and of *morbidezza*. With him originated

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a new type of the Madonna, afterward given its highest expression by Leonardo and Raphael,—a presentation in which only the human idyl of motherly love and infantile innocence is sought. In the religious as in the allegorical and mythological subjects of Sandro Botticelli (q.v.), something of the mediæval awkwardness of expression reappears, redeemed by the grace and charm of the conception and the color. With him are associated as exponents of a modern, ingenious spirit, Benozzo Gozzoli (q.v.), a pupil of Fra Angelico, and Pinturicchio (q.v.). Andrea Verrocchio (q.v.) is most popularly known as a sculptor, principally by his equestrian statue of Colleone, the Venetian general; Domenico Ghirlandaio (q.v.), less original than Masaccio but more finished in his expression of realism, was, next to him, the most important painter of the Florentine school of the 15th century, and had for a pupil Michelangelo.

Of the Umbrian school, the chief seat was Perugia, though in this province painting was not centralized in the cities; the mystical and serene spirit of Perugino differed from the vivacious and investigating character of his predecessors in the school. The first artist to feel the influence of Florence was Piero degli Franceschi (q.v.), but a more skilful was Luca Signorelli (q.v.), his pupil, whose great painting of the 'End of the World,' in the chapel of the cathedral of Orvieto (which had been commenced by Fra Angelico), furnished themes and figures to Michelangelo for his 'Last Judgment.' In the best works of the master of Raphael, Pietro Vanucci (q.v.), called Perugino, may be seen the same art, the same suavity and dignity, which characterize much of the early work of his famous pupil; he seems to have been the first in central Italy to master completely the new process of painting in oil.

In northern Italy, the most important centre of the arts was at Padua, the school there having been founded in the second half of the 15th century by Francesco Squarcione (q.v.), known as the "Father of Painters," and the discoverer of the genius of Andrea Mantegna (q.v.), whom he adopted at the age of 10. In this latter artist, one of the most learned, ingenious and original of his age, the first to master the complete rules of composition, the study of nature was happily balanced by a corresponding study of the antique. In Venice, enjoying a most unusual order and prosperity under the intelligent despotism of her dukes, the revival of art did not manifest itself strongly until the second half of this century, but its final florescence was one of the most brilliant of any age. Two families of painters appear in this first period, the Vivarini and the Bellini, the latter much the more famous. To them Antonello da Messina seems to have communicated the method of painting in oil, which they so soon mastered,—a love of color and splendor being one of the natural gifts of the Venetians. The head of the family was Jacopo Bellini (q.v.), who went to Florence early in his career; his sons were Gentile (q.v.) and Giovanni (q.v.), the latter praised by Albrecht Dürer at the period of his visit to Italy in 1506. In the works of these Venetians appears that "atmosphere" which is so diligently sought by the modern schools,—the feeling of space and air, of the relative position and value

of the figures in the general arrangement; the Gothic angularity and awkwardness have been replaced by a fuller knowledge. The most eminent of the followers of Gentile Bellini was Vittore Carpaccio (q.v.) (Scarpaccia), famous for his cycle of nine pictures illustrating the legend of Saint Ursula.

The greatest name in the Renaissance proper is that of Leonardo da Vinci (q.v.), b. 1452, distinguished as a scientist, an architect, a sculptor, a musician, an author, and a painter,—and qualifying painting, himself, as the noblest of the arts and as at the same time a science. But few of his pictures survive, the most famous and the most wonderful being the portrait known as the 'Mona Lisa' in the Louvre. Of his numerous followers, the most productive and the most successful in expressing some of his qualities was Bernardino Luini (q.v.). Michelangelo (q.v.), on the other hand, vehemently protested against placing painting on a level with sculpture, and, indeed, remained to the end of his days "*Michelangiolo Scultore*" rather than the painter, even in his greatest mural decorations. His first patron was Lorenzo de Medici; and it was in 1508 that the pope Julius II. commissioned him to paint the ceiling of the Sistine Chapel in the Vatican. In 1535 he commenced the 'Last Judgment' on the end wall, and it was unveiled for the Christmas festival of 1541. The qualities of his rugged genius were peculiarly those best adapted to create a school of mannerisms and conventions among his imitators, and we see his influence very strongly developed even in his lifetime, and even in the favorite pupil of Raphael, Giulio Pippi, called Giulio Romano (q.v.). To this pretentious and ignorant school of exaggerated muscular action and violent foreshortening, which flourished during the decadence of the art, was given the name of the Baroque. The art of Raphael Santi da Urbino (q.v.), so different in quality, was eminently qualified by its combination of academical distinction with suavity and grace to secure the largest need of popular favor in his own time and in succeeding ages, and his 'Madonna Sistina,' now in the Dresden Gallery, was accepted for more than three centuries as the greatest painting in the world. Andrea del Sarto (q.v.), the best colorist in the Florentine school, may be said to err only in a certain lack of deep feeling; and the versatile talent of Correggio (q.v.) leads up to the splendors of the later Venetian school of Giorgione, Palma, Vecchio and Titian, and, later still, of Paul Veronese, Tintoretto and Tiepolo, the apotheosis of the beauty of oil painting. Giorgio da Castelfranco (q.v.), so great a Giorgio that he was called Giorgione, that is, Big George, was a fellow student with Titian under Giovanni Bellini. But very few of his authenticated works survive, one of them being in the Louvre. Of Giacomo Palma, the elder (q.v.), called Palma Vecchio, more is known, over a hundred existing paintings being attributed to him, the finest being probably the altar-piece in S. Maria Formosa, Venice, a single figure of Saint Barbara. With the majestic figure of Titian, Tiziano Vecelli da Cadore (q.v.) (1477-1576), the golden period of the Renaissance may be said to end,—of all the numerous assistants who worked under him during his long life, including a brother

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and a son, none inherited his power. His paintings, sacred, allegorical, mythological, and portraits, are preserved in all the great galleries of Europe; the most beautiful, and perhaps the most characteristic of this school being the so-called 'Earthly and Heavenly Love' in the Borghese Palace in Rome. For painting after 1550, see POST-RENAISSANCE PAINTING.

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WILLIAM WALTON,

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Renan, rê-năn, **Ernest**, French historian, philosopher, and essayist: b. Tréguier, Cote-du-Nord (Brittany), 27 Feb. 1823; d. Paris 2 Oct. 1892. The priests who directed the school in Tréguier conducted his education up to his 16th year. Having proved himself a scholar of distinction, Renan was chosen in 1838 by the Abbé Dupanloup for a place in the seminary of Saint Nicolas du Chardonnet in Paris. Here he remained until, in 1842, he went to Issy, near Paris, to receive a training in philosophy previous to his entering upon his studies for the priesthood. In 1844 he was admitted to the seminary of Saint Sulpice, the chief training school of the French priesthood, where he acquired a knowledge of Hebrew, Arabic, and Syriac. The result of these studies in philology was to shake his belief in Catholic orthodoxy, and finding it impossible to enter the priesthood he quitted the seminary in 1845. While he now maintained himself by teaching in a school at Paris, he continued his historical and philological studies, aided by the counsel and assistance of his sister Henriette. In 1848 he received the Volney prize for an essay on the Semitic languages, amplified and published as 'Histoire générale et Système comparé des Langues sémitiques' (1855). In the following year he was sent on a mission to Italy by the Académie des Inscriptions et Belles-Lettres, and returning was appointed to a post in the manuscripts department of the Bibliothèque Nationale. His 'L'Avenir de la Science,' though not published till 1890, was written in 1848-9. He next published 'Averroës et Averroïsme' (1852), and several 'Etudes d'Histoire religieuse' (1856). Having become known as an Oriental scholar, he was appointed a member of a commission sent by the government in 1860 to examine the remains of Phœnician civilization in Syria. It was during this journey in Pales-

tine that he wrote his famous 'Vie de Jésus' (1863). He afterward dedicated it to his sister Henriette, who, having accompanied him, had died at Byblos. During his absence Renan had been appointed professor of Hebrew in the Collège de France, but some expressions of a Unitarian character in his inaugural address conspired with his well-known hostility to traditional Christianity to deprive him of his chair, in which he was not reinstated until 1871.

The publication of the 'Life of Jesus' in 1863 gained for its author a European reputation, and was the first of a series on the 'Histoire des Origines du Christianisme,' which he made the chief labor of his life. This comprehensive work included the following further volumes: 'Les Apôtres' (1866); 'Saint Paul' (1869); 'L'Antéchrist' (1871); 'Les Evangiles et la Seconde Génération Chrétienne' (1877); 'L'Eglise Chrétienne' (1879); 'Marc Aurèle et la Fin du Monde Antique' (1882); 'Index Général' (1883). In 1888 he was elected a member of the French Academy. During 1880 he delivered the Hibbert lectures in London on 'The Influences of the Institutions, Thought, and Culture of Rome on Christianity,' and also, at the same time, lectured at the Royal Institution on Marcus Aurelius. In 1883 he was appointed administrator of the Collège de France, where he continued his labors until his death. It is not yet possible to decide with any degree of certainty the ultimate effect of his work on the religious thought of Europe; but to his own generation he was a man of unique personality, and a writer of great erudition. Besides the works already enumerated the following should be mentioned: 'De L'Origine du Language' (1857); 'Le Livre de Job' (1859); 'Essais de Morale et de Critique' (1859); 'Le Cantique de Cantiques' (1860); 'Mission de Phénicie' (1865-74); 'Questions contemporaines' (1868); 'La Réforme Intellectuelle et Morale' (1872); 'Dialogues philosophiques' (1876); 'Mélanges d'Histoire et de Voyages' (1878); 'Corpus Inscriptionum Semiticarum' (1881-9); 'L'Ecclesiaste' (1882); 'Souvenirs d'Enfance et de Jeunesse' (1883); 'Nouvelles Etudes d'Histoire religieuse' (1884); 'Discours et Conférences' (1887); 'Histoire du Peuple d'Israël' (1887-94); 'Feuilles détachées' (1892); and several dramas, such as 'Caliban' (1878), 'L'Eau de Jouvence' (1880), 'Le Prêtre de Nemi' (1885), and 'L'Abbesse de Jouarre' (1886). His 'Lettres intimes' (1896) are a fitting memorial of his devoted attachment to his excellent sister Henriette.

Around Renan's writings were waged bitter controversies "whose volume is rivalled only by their acrimony." Into those discussions it is not now necessary to enter. Renan was a kind of Democritus, viewing the world as "a charming promenade," or a pleasing spectacle with Renan in an orchestra-stall; speaking of it all with an amiable irony. Truth was to him a diamond of many facets, and he was never ready to define his position. One thing, indeed, he was confident of—his own genius. Yet he was compact of strange contradictions; for he said that he alone in his time comprehended Saint Francis of Assisi, urged doubtful priests to remain in the church, and having, as most thought, struck as severely as he could at faith, deplored its passing in France. The 'Vie de Jésus' was received

by even French readers with a large reserve on the score of taste. Based on the critical work of radical German theologians, it endeavored to reconstruct the life of Christ by the so-called scientific method of history and psychology, and to treat a subject which previous critics had approached with respect for its special character, in a manner which at times amounted almost to caricature. Renan's style has been highly praised for simplicity and restraint. His influence remains strongly in French literature. The best biography of Renan is that of Madame Darmesteter (1898). Consult also: Sainte-Beuve, 'Nouveaux Lundis' (1863-72); Grant Duff, 'In Memoriam' (1893); Monod, 'Maitres d'Histoire' (1895).

René, *rě-nā*, or **Renatus I.** (*rě-nā'tūs*) of **Anjou** (called also **THE GOOD**), titular king of Naples: b. Angers 16 Jan. 1409; d. Aix 10 July 1480. He was the second son of Louis II., Duke of Anjou. He inherited Anjou and Provence, besides claims upon Naples, Sicily, and Jerusalem from his brother Louis III. in 1434, and these rights were confirmed by Joanna II. before her death in 1435. René had in 1420 married the daughter of Charles II., Duke of Lorraine, and had in 1431 become possessed of that dukedom. But in the same year Count Antony of Vaudemont took him prisoner, whereupon the Lorraine states appealed to the Emperor Sigismund to decide the quarrel. René in 1432 was released from his prison for a year by giving his sons as hostages. At last, in 1434, Sigismund gave a decision in René's favor. The dethroned Antony proceeded to the Duke of Burgundy, who required René again to place himself in custody. Scarcely had this been done when an embassy arrived to tender him possession of Naples and Sicily. Philip refused to set René at liberty, and the ambassadors therefore conferred the crown on his wife Isabella, whom her husband named regent of Anjou, Provence, Naples, and Sicily. Isabella set sail for Naples, but there found a competitor in Alfonso, king of Aragon, who maintained his position not only against her, but also against René himself, after he had obtained his liberty in 1437. René, obliged to abdicate, returned to Provence. The government of Lorraine he gave up to his son John, who, after his mother Isabella's death, entered into full possession under the title of John II. On this René retired to Provence to give himself to poetry and the arts. His literary remains were edited by Count de Quatrebarbes (1875).

René II., count of Anjou, grandson of René I.: d. 1508. He inherited Vaudemont, Joinville, Aumale, Mayenne, and Elbœuf in 1470 from his father, Frederick II.; and Lorraine from his mother in 1473. In 1480 he acquired the dukedom of Bar. He fought with the Swiss against Charles the Bold of Burgundy in 1477. After his grandfather ceded Lorraine to Louis XI. he tried to establish his rights by force of arms.

Renée of France, **Duchess de Ferrara**, French princess, daughter of Louis XII.: b. Blois, France, 1510; d. Montargis, France, 1575. She was highly educated, possessed a keen intellect, and took a deep interest in religious controversies. In 1527 she was married to the Duke de Ferrara and in 1535 was converted to

Protestantism by Calvin. Her conduct was displeasing to her father who caused her four children to be taken from her and educated in the Catholic faith, and also ordered severe restrictions concerning the princess' freedom of action and compelled her to attend mass. After the death of the duke in 1559 she returned to France and resided in her castle of Montargis, where she was the patron of the French Huguenots and also of various literary celebrities. Consult: Catteau-Calleville, 'Vie de Renée de France' (1781); 'Memorials of Renée of France, Duchess of Ferrara' (1859); Fontana, 'Renata di Francia, duchessa di Ferrara' (1888-93); Rodocanachi, 'Renée de France' (1896).

Ren'egade, one who renounces his religious belief and adopts another; in particular one who gives up Christian belief for Mohammedanism: a renegade is also a traitor who, deserting the cause of his country, enters the service of his country's enemies. Among famous renegades in this sense are: Hippas, the Athenian, son of Pisistratus, who fought on the side of Sparta against Athens, and afterward joined the Persians; the Roman patrician Coriolanus, who, when exiled from Rome, took up arms with the Volscians against his country; in the Thirty Years' war, Count Mansfeld, who deserted from the Catholic to the Protestant side, and Pappenheim, who deserted from the Protestant side to the Catholic; in the 18th century the Duke de Ripperda, who had won distinction in the military service of Spain, embraced Islam and led the armies of Morocco against Spain.

Reni, Guido, *gě'dō rā'ně*, Italian painter: b. Bologna 4 Nov. 1575; d. there 18 Aug. 1642. His first instruction was received in Calvaert's celebrated school at Bologna where he studied the works of Albrecht Dürer. When the school of the Caracci, at Bologna, began to eclipse that of Calvaert, Guido, then 20, joined it. He visited Rome for the first time in 1602, with two of his fellow students, Domenichino and Albano. He made a second visit in 1605 and Cardinal Borghese employed him to paint a 'Crucifixion of Saint Peter' (now in the Vatican) for the church Delle Tre Fontane. The powerful manner of this picture, and several others of the same period, which manner Guido did not, however, long retain, increased his fame; and at the cardinal's request, he completed the 'Aurora' on the ceiling of the Casino in the Rospigliosi Palace. This picture has become well known and popular from the engravings of it by R. Morghen, J. Burger, and others. Paul V. at that time employed Guido to decorate a chapel on Monte Cavallo, with scenes from the life of the Virgin Mary. Guido accomplished this work to the satisfaction of the pope, and was next entrusted with the painting of the memorial chapel in Santa Maria Maggiore: To this period his 'Fortuna,' and the portraits of Sixtus V. and Cardinal Spada may be assigned. His paintings are very unequal in style and character, but generally are considered as belonging to three different manners and periods. The first comprises those pictures which resemble the manner of the Caracci, and particularly that of Caravaggio. Faces and forms, stately and grandiose, deep shadows, narrow and intense lights, high coloring, in short, an effort after great effect, distinguish his works of this first

period. The second manner is completely opposed to the first and shows the painter at his best, being sweet, natural, and unstrained. Its principal features are tender coloring, little shade, an agreeable, though often too dainty, airy and sentimental, treatment of the subject, constituting a style quite peculiar to Guido. His 'Aurora' forms the transition from the first to the second style of his paintings. A third period commences at the time when Guido worked with too much haste and had become more avaricious of money than of fame. His coloring has turned to a greenish and altogether unnatural grayness, and the general treatment is careless and weak. During the government of Pope Urban VII. Guido quarreled with his treasurer, Cardinal Spinola, respecting the price of a picture, and returned to Bologna. There he had already executed his 'St. Peter and Paul' for the house Zampiere, and the 'Murder of the Innocents' for the Dominican church, and was on the point of embellishing the chapel of the saints with his pictures when he was called back to Rome, loaded with honors, and received by the pope himself most graciously. But he soon experienced new difficulties, and in 1622 accepted an invitation to go to Naples. Believing himself unsafe at this place, on account of the hatred of the Neapolitan artists for foreign painters, he returned once more to his native city, never to quit it again. At Bologna he painted two beautiful pictures for the church Dei Mendicanti, an 'Assumption' for Genoa, and a number of others for his native city and other places, particularly for Rome. There is also a 'Magdalen' by this artist in Chiswick House, belonging to the Duke of Devonshire, of which there is an engraving by Sir Robert Strange. Equally celebrated is a painting of 'Lot and his Daughters,' in the Hampton Court collection, also engraved. In the gallery of the Louvre are several, of which the finest is the 'Centaur Nessus carrying off Dejanira.' In the Dresden Gallery is his 'Christ Wearing the Crown of Thorns.' Consult Bolognini-Amorini, 'Vita del celebre pittore Guido Reni' (1839).

Rennell, rĕn'ĕl, James, English geographer: b. Chudleigh, Devonshire, 3 Dec. 1742; d. London 29 March 1830. At 13 he entered the navy as midshipman, and was present at the siege of Pondicherry. In 1763 he entered the East India Company's sea service; the next year was appointed surveyor-general of the East India Company's dominions in Bengal and remained in the service for 13 years. Returning to England in 1777 he published his 'Bengal Atlas' (1779), a work of the highest importance for administrative and strategical purposes. This was followed by the earliest approximately correct map of India with a memoir (1783). The Royal Society, of which he had been a fellow for 10 years, gave him the Copley medal in 1791. His attention was thereafter directed to comparative geography, and in pursuance of his scheme for a great work on western Asia he published 'Geographical System of Herodotus Explained' (1800); 'Observations on the Topography of the Plain of Troy' (1814); and 'Illustrations of the Retreat of the Ten Thousand' (1816). Finally came 'A Treatise on the Comparative Geography of Western Asia' (1831). He contributed much to the field of African geography, constructing a map of north-

ern Africa for the African Association, and determining the routes taken by Hanno and in his own day by Mungo Park. Throughout his life he had been interested when not personally occupied in marine surveying and collected an immense mass of data which he began to reduce to a system about 1810. He completed current-charts of the Atlantic which were published after his death; and the name of 'Rennell's Current' was given to the current to the southward of the Scilly Islands, whose occasional northward set he was the first to explain. He published papers on the ruins of Babylon, the identity of Jerash, the shipwreck of Saint Paul, and the landing of Cæsar. In 1801 he was made an associate of the Institute of France, and in 1825 received the gold medal of the Royal Society of Literature. He was buried in Westminster Abbey. Consult: Markham, 'Major James Rennell and the Rise of Modern English Geography' (1895).

Rennes, rĕn, France, capital of the department of Ille-et-Vilaine (formerly capital of Brittany), situated at the junction of the rivers Ille and Vilaine. It is divided by the Vilaine, traversing the city from east to west, into the High and Low Town. The High Town is elegantly built on the right bank of the river; the Low Town is unprepossessing and older (11th-13th century), and suffers from frequent inundations. The buildings of interest are: The cathedral of Pseudo-Ionic style; the archiepiscopal palace; the old parliament house; and the statues of many celebrities; the town-house, containing a fine picture gallery, Veronese, Michelangelo, Tintoretto, Van Dyck, Rembrandt, and Rubens; splendid scientific and other collections; important archives, and a large library. Rennes has courts of justice of first and second instance. The industries embrace tanneries, wax-bleaching, printing, stained paper, hats, boots and shoes, gloves, and agricultural implements. There is an extensive trade in butter, honey, wax, cotton, and linen yarns, lace, earthenware, etc. Rennes is very ancient, dating from Condé, the capital of the Gallic Redones. Pop. about 75,000.

Rennet, the prepared inner surface of the stomach of a young calf. It contains much pepsin, and has the property of coagulating the casein of milk and forming curd. It is prepared by scraping off the outer skin and superfluous fat of the stomach when fresh, keeping it in salt for some hours, and then drying it. When used a small piece of the membrane is cut off and soaked in water, which is poured into the milk intended to be curdled.

Rennie, rĕn'ĭ, George, English civil engineer, son of John Rennie (q.v.): b. London 3 Dec. 1791; d. there 30 March 1866. He was educated at the University of Edinburgh and in 1811 entered the office of his father. He was inspector of machinery of the mint in 1818-26 and in 1821 engaged with his brother Sir John Rennie (q.v.) in completing several important works begun by their father, among which were the breakwater at Plymouth, various docks, harbors, canals, and the London Bridge. He laid out the Liverpool and Manchester railway in 1826, was chief engineer of the Namur and Liège railway in 1846, constructed the first screw-propelled ship in the British navy, the *Mermaid*, in 1840, and was engaged in the construction of

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naval works at Sebastopol, and other foreign ports besides those in English harbors. After the retirement of his brother, Sir John, in 1845, he conducted the business of the firm in partnership with his two sons. He was made a fellow of the Royal Society in 1822, was its vice-president in 1845, and treasurer in 1845-50.

Rennie, John, Scottish civil engineer: b. Phantassie, Haddingtonshire, 7 June 1761; d. London 4 Oct. 1821. At an early age he showed an interest in mechanics and frequented the shop of the millwright Andrew Mickle, inventor of the threshing machine. Later he spent three years at Edinburgh University, and in 1784, having already established a business of his own, he visited James Watt at Soho, Staffordshire, and by Boulton and Watt was engaged to take charge of the work of the Albion Flour Mills, Blackfriars, London. Rennie designed all the machinery, using iron instead of wood for the shafting and framing. In London his reputation rapidly increased, until he was ranked foremost among the civil engineers of Great Britain. Among his public works may be mentioned Ramsgate Harbor; Waterloo and Southwark Bridges, across the Thames, and the design of London Bridge, the structure being completed after his death; the breakwater at Plymouth, and several similar structures, where submarine masonry was carried to great perfection. He superintended likewise the execution of the Grand Western Canal, from the mouth of the Exe to Taunton; the Polbrook Canal, Cornwall; the Aberdeen Canal, uniting the Don and the Dee; that between Arundel and Portsmouth; and, his chief work in connection with inland navigation, the Kennet and Avon Canal, between Bath and Newbury, the London Docks, the East and West India Docks, the Prince's Dock at Liverpool, and those of Dublin, Greenock, and Leith were also designed by him. In prosecuting his works he made use of the diving-bell which he greatly improved, and the steam-dredging machine, apparently without the knowledge that in its invention he had been anticipated by Sir Samuel Bentham.

Rennie, Sir John, English civil engineer, younger son of John Rennie (q.v.): b. London 30 Aug. 1794; d. Bengoe, near Hertford, Hertfordshire, 3 Sept. 1874. At 16, he like his brother, began the study of engineering under his father. When his father died in 1821 he continued with his brother George to carry on the extensive business left in their hands. He made hydraulic engineering a special study, and through his efforts large tracts of land on the eastern coast of England, including part of the Lincolnshire fens, were reclaimed and made extremely productive. The finest works of the Rennies are their bridges, which may be seen in all parts of England and Scotland, London Bridge being the most massive of them all. On the occasion of the opening of this bridge in 1831 John Rennie was knighted, an honor his brother declined. After the dissolution of the partnership in 1845 Sir John practised as an architect. He introduced the system of railways in Sweden, made important surveys of the harbor of Oporto in Portugal, and designed, and in great part executed, the harbor of Ponte Delgada in the Azores, one of his latest public works. In 1845 he was elected president of the Institute of Civil Engineers. He was the author

of 'Theory, Formation and Construction of British and Foreign Harbors' (1851-4). Consult his 'Autobiography' (1875).

Ren'no Renappi, the native name for the Delaware Indians (q.v.).

Reno, ré'nô, Conrad, American lawyer: b. Alabama 28 Dec. 1859. He was graduated from the Boston University Law School in 1883 and has since practised his profession in Boston. He has published: 'State Regulation of Wages' (1891); 'Non-Residents and Foreign Corporations' (1892); 'Employers' Liability Acts' (1896-1903); 'History of the Judicial System of New England' (1900).

Reno, Jesse Lee, American military officer: b. Wheeling, W. Va., 20 June 1823; d. South Mountain, Md., 14 Sept. 1862. He was graduated from West Point in 1846, served with distinction in the Mexican War, was assistant professor of mathematics at West Point in 1849 and at the outbreak of the Civil War was commissioned brigadier-general of volunteers. He performed gallant service at Roanoke Island, Newbern, and Camden, and was promoted major-general in 1862. He participated in the battles at Manassas and Chantilly, and after repulsing the Confederates under General Lee at South Mountain, three days before the battle of Antietam, he was killed while leading a charge.

Reno, Jesse Wilford, American inventor, son of J. L. Reno (q.v.): b. Fort Leavenworth, Kan., 4 Aug. 1861. He was graduated from Lehigh University in 1883, afterward pursuing a special course in mining and engineering. In 1885-90 he was engaged in mining in Colorado, and later became an electric railway expert. In 1892 he invented the inclined elevator or moving stairway (see ESCALATOR) and in 1895 became president of the Reno Inclined Elevator Company.

Reno, Marcus Albert, American military officer: b. Illinois, about 1835; d. Washington, D. C., 31 March 1889. He was graduated from West Point in 1857, and at the outbreak of the Civil War was made 1st lieutenant in the United States army. He was promoted captain in the same year, brevetted major for gallantry at Kelly's Ford, Va., in 1863, lieutenant-colonel for services at Cedar Creek, and in 1865 was brevetted brigadier-general of volunteers and colonel of regulars for distinguished service throughout the war. In 1876 he was engaged in the campaign against the Indians under Sitting Bull, holding command second to General Custer. In the engagement in which Custer and nearly all his regiment were killed, Reno escaped through cowardice and in consequence of his failure to support his associates and other serious charges he was dismissed from the service.

Reno, Nevada, city, county-seat of Washoe County; on the Truckee River, and on the California & O., the Southern Pacific, and the Virginia & T. R.R.'s; in the extreme western part of the State, about 30 miles south of Carson City. It was settled in 1858 by eastern emigrants who had started for California. It was incorporated in 1869, and in 1901 was chartered as a city. It is in a farming and stock-raising region, and is the most important and largest city in the State. The chief industrial establishments are railroad machine shops, which have 2,200 employees; abattoir and packing house, 120

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employees; electric-power plant, 50; pressed brick works, 25, and a number of smaller manufacturing works. The trade is chiefly in farm products, live-stock, and manufactures. It is an important distributing point for a vast territory. The principal public buildings are a government building, eight churches, and the Nevada State Hospital for Mental Diseases. The educational institutions are the State University, opened in 1886, State Agricultural College and Experiment Station, a normal school, Academy of Our Lady, public and parish schools, and a Carnegie Library. The three banks have a combined capital of \$1,500,000, and the annual amount of business is \$38,000,000. The government is vested in a mayor and a city council of five members, all of whom are elected by the people. Pop. (1890) 3,563; (1900) 4,500; (1910) 10,657.

C. A. NARCROSS,

Editor 'Reno Evening Gazette.'

Renoir, ré-nwâr, Auguste, French painter: b. Limoges 1841. He exhibited at the first Impressionist Salon in 1874 after studying under the impressionist Monet and others of the same school. While he paints figures, principally, and possesses singular skill in depicting flesh color and skin texture, as well as facial expression, he has remarkable success in landscape, in fruit and in flowers, which he sets on the canvas with astonishing boldness, and vividness of presentation, and he is certainly one of the most original and independent of the school to which he belongs. His 'Jeunes Filles au Piano' is a good example of his qualities. Among his portraits are those of Claude Monet, his master, and the composer Wagner. Consult: Duret, 'Les Peintres Impressionistes' (1879).

Renouf, rê-noof, Emile, French painter: b. Paris 1845; d. there 1894. He chose for his subjects the scenery of the sea and incidents in the lives of those who live on the seashore, fishermen, etc., but he also did some good work in landscape and genre. His fine marine 'After the Storm' is in the New York Metropolitan Museum, and his 'Helping Hand' (a child holding to an oar, while a sturdy fisherman rows), is in the Corcoran Gallery, Washington. While in New York (1887-8) he painted 'Brooklyn Bridge,' which at present is in the public gallery at Havre. In 1883 he was awarded a first class medal at Munich.

Renouf, Sir Peter Le Page, English Egyptologist: b. Guernsey 23 Aug. 1822; d. London 14 Oct. 1897. He was educated at Elizabeth College, whence he passed to Pembroke College, Oxford, where he came under the influence of Newman and the Tractarians, and in 1842 entered the Roman Catholic Church. From 1855 to 1864 he was professor in the Catholic University of Ireland, first of French literature and the history of philosophy, and subsequently of ancient history and Oriental languages. He began his career as an Egyptologist about 1860, and in 1863 defended the work of Young and Champollion against Sir George C. Lewis. He opposed the dogma of papal infallibility, and in connection with this subject wrote on 'The Condemnation of Pope Honorius' (1868) and 'The Case of Pope Honorius Reconsidered' (1869). From 1866 till 1885 he was an inspector of schools, and during 1885-91 he was keeper of

the Egyptian and Assyrian antiquities in the British Museum. In 1875 he published 'An Elementary Grammar of the Ancient Egyptian Language' (2d ed. 1896), and in 1879 delivered a course of Hibbert lectures on the 'Origin and Growth of Religion as Illustrated by the Religion of Ancient Egypt' (1880; 2d ed. 1884). He was knighted in 1896 for distinguished scholarship. He left unfinished a translation of the 'Book of the Dead,' with commentary, which at the time of his death was in course of publication (1892 et seq.) in the 'Proceedings' of the Society of Biblical Archaeology, of which he was president from 1887. The work was completed from Renouf's notes by E. Naville. Renouf was one of the most careful and trustworthy Egyptologists of his time, and, besides, a most versatile linguist. For a sketch of him, with a bibliography of his writings, consult the 'Proceedings' of the Society of Biblical Archaeology (Vol. XIX., 1897).

Renovo, rê-nô'vô, Pa., borough in Clinton County; on a division of the Pennsylvania railroad; about 125 miles northeast of Pittsburgh and 25 miles northwest of Lock Haven. It is in a region of the Alleghany Mountains noted for grand scenery, and an abundance of game. Renovo is a summer resort which is growing in favor. It has considerable industrial interests connected with the extensive bituminous coal-fields and the fire-clay deposits in the vicinity. The chief industrial establishments are the Pennsylvania railroad shops, the coal yards, and the brick works. Pop. 4,200.

Rensselaer, rên'se-lér, Ind., city, county-seat of Jasper County; on Iroquois River, and on the Chicago, Indianapolis & Louisville railroad; about 100 miles northwest of Indianapolis. It was settled in 1834 by David Nowles, John Nowles, and Joseph Yeoma. It was incorporated in 1850, and chartered as a city on 1 May 1890. Rensselaer is in an agricultural region; and its manufacturing industries are chiefly connected with farm products. It ships considerable farm produce and live-stock. There are five churches, a high school, public elementary schools, and business schools. The four banks have a combined capital of \$100,000, and the annual amount of business is \$3,000,000. The government is vested in a mayor and a council of six members elected biennially. Pop. (1890) 1,455; (1900) 2,255; (1910 est.) 2,600.

Rensselaer, N. Y., city in Rensselaer County; on the Hudson River, and on the Boston & A., and the New York C. & H. R. R.R.'s; opposite Albany and six miles south of Troy. It is connected with Albany, Troy, and other cities by electric lines; and it has connection by steamboat with many of the cities and towns on the river. Three large bridges span the Hudson and connect Rensselaer with Albany. The first settlement was made by the Dutch. It was incorporated as a village in 1815 and in 1897 was chartered as a city. It was called Greenbush until it became a city, when it took the name Rensselaer. The village of Bath was annexed in 1902. Rensselaer is a commercial and manufacturing city. The chief manufacturing establishments are a felt factory, tannery, aniline works, and shirt-waist factory. A large number of persons are employed in connection with the railroads and steamboats, and in the offices,

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stores, and manufactories in Albany and Troy. There are 10 churches, two public schools, one parish school, Saint John's Academy, and Saint John's Orphan Asylum. The government is vested in a mayor and a common council of 10 members, elected biennially. Pop. (1900) 7,466; (1910) 10,711. The addition of Bath increased the population of the city about 3,100.

Rensselaer Polytechnic Institute, located at Troy, N. Y. It was founded by Stephen Van Rensselaer in 1824 as a school of practical science, being the first school of science and the first school of engineering to be established in any English-speaking country. It was first opened to students in January 1825, and incorporated in March 1826. It was at first named the Rensselaer School; afterward the Rensselaer Institute, and finally the Rensselaer Polytechnic Institute. Lectures on land surveying and engineering were given as early as 1823; and after 1850 the Institute became more distinctly a school of civil engineering; the course at that time was lengthened from one year to three years. It now offers two courses of four years each, one in natural science and one in civil engineering. These courses include instruction in chemical analysis, mineralogy, metallurgy and assaying, as well as in the design and construction of roads, railroads, bridges, roofs, arches, dams, steam engines, electric engines, dynamos, turbines, foundations, waterworks, tunnels, sewers, and canals. The degrees of B.S. and C.E. are conferred. The students in 1910 numbered 626, and the faculty 53: Its influence has been widespread. Students have come to it from 42 of the States of the Union and 25 foreign countries, and its graduates are at present practising their profession in 45 of the States and 19 foreign countries. Its standing as a professional school is shown by the following extract from the report to the German government by Professor A. Riedler of the Royal Polytechnicum of Berlin: "The greatest number of renowned hydraulic and railroad engineers of America are graduates of this school."

PALMER C. RICKETTS,
Director of the Rensselaer Polytechnic Institute.

Rents, Law of. Rent has been defined as a certain profit, in money, provisions, chattels or labor, issuing out of lands and tenements in retribution for their use; or, rent is a definite compensation reserved by lease, to be made periodically, and payable in money, produce, other chattels, or labor, for the possession and use of land and tenements. Where one person occupies land or premises of another under an agreement, express or implied, there exists the relation of landlord and tenant. The landlord is a person whose lands are occupied and the tenant is one who occupies same. A sub-tenant is one who leases all or part of the premises from the original tenant. The relation of landlord and tenant is generally created by a lease, although it may exist without an agreement and without liability on the part of the tenant, and may arise by implication if the acts of the parties are consistent with it. The terms lessor and lessee respectively, designate the landlord and tenant. A lease is a contract by the owner of lands or tenements on one side, with one who is to pay a rent or income for its use; it differs materially from a license, which is merely a permission to perform some act with respect to land belonging

to another; mere occupancy of land under an agreement to cultivate it for a share of the crops does not establish the relation of landlord and tenant; whether or not such relation may exist, in some cases depends on the intention of the parties. A tenant continuing to occupy premises without the consent of the landlord, and after the term of his lease has expired is a tenant at sufferance, which may be terminated at the will of the landlord, or by a new tenancy, either express or implied. Where premises are leased to be occupied for such time as may be desired by the other party, it is termed a tenancy at will; such a tenancy exists when one occupies premises with the owner's permission without paying rent.

Tenancy at will is held to exist in the following cases: where one takes possession under a conveyance, lease, or contract for sale, that is invalid; or where one takes possession while negotiations are pending for a lease, or for purchase, and where one takes possession under an agreement for a lease. Statutes in some jurisdictions hold that a tenancy not governed by a lease is a tenancy at will. A tenancy at will may be terminated where the landlord leases the property to a third person for a term of years, by the death of either the landlord or tenant, by the sale of the property, or by any act on the part of the landlord amounting to a demand for possession or showing such intention. In some jurisdictions statutes require a formal notice. A tenant at will, unless it is distinctly stipulated to the contrary, is liable for a fair rental of the premises. The lessee is liable for the rent agreed upon, whether or not he takes possession; it has been held by a number of courts that an exception to this is where the premises are destroyed before the beginning of the term. Unless contained in the agreement, a landlord is not compelled to make repairs, nor is he liable for them, or any injury caused by the condition of the premises,—not even if the repairs are on account of injury by adjoining buildings. Where buildings are destroyed by fire or accidental cause, the landlord is under no implied obligation to rebuild them; if he does so, however, the tenant is entitled to occupy the new building. Where one rents part of a building, it is generally held that the landlord is under no implied obligation to keep any other part of such building in repair. Landlords are generally liable to tenants for injuries due to accidental defects, and for any negligence on his part, in relation to a part of the building occupied by another tenant, or a portion thereof, that is under his control, and is obliged to keep in repair the portion that is rented, but is under no obligation to one tenant to repair a part of the building leased to another tenant. It is an implied duty on the part of the landlord to keep passageways and approaches used by several tenants, in repair; but, unless so required by the law, or his contract, he is not obliged to keep the passageways lighted. It is also his duty to prevent any obstruction of a passageway, which would make it dangerous, and it has been held that it is a landlord's duty to remove accumulations of ice and snow.

It is held in some jurisdictions that where a building is rented to a number of tenants, it is the duty of a landlord to keep water pipes in repair and that he is liable for any negligent use,

RENUNCIATION — REPEATER

through himself or his agent, or servants, of the water, but not for the negligence of another tenant. Notice must be given to a landlord of defects in the premises in order to render him liable for negligence in relation thereto. Generally a landlord is liable for concealing dangerous defects on the premises. An agreement to make repairs does not require the landlord to include such repairs as may be necessary from the carelessness of the tenant; on failure to make repairs in accordance with an agreement, the tenant can make the repairs and recover the cost from the landlord or bring an action on the contract and if the premises become untenable for the want of repairs the tenant may abandon the premises; a tenant must make a demand for the repairs in order to entitle him to any remedy. Repairs made by the landlord must be executed with care, and he is liable for any injury that may occur therefrom. Where premises that are in proper condition at the time of being rented, are allowed to come in a dangerous condition, a tenant is as a rule liable for injuries, such as may occur from falling roof, or defective sidewalk. It is a principle well established that a tenant cannot dispute a landlord's title except when the landlord was induced by fraud or misrepresentation to become such. An action at law at any time can be maintained by the landlord, or his assignee, to recover rent, and under ordinary circumstances no prior demand is necessary; in many jurisdictions a landlord is authorized to attach the property of a tenant. The various matters and things concerning the renting of property, and the relations of landlord and tenant, have been made the subject of statutes in some jurisdictions, and vary the general laws and customs governing these subjects.

HENRY M. EARLE.

Renuncia'tion, in law, the act of giving up a right, such as the position of an executor or administrator of an estate, or any other office, charge or claim to which the person renouncing is legally entitled. There are proper legal forms for such action.

Ren'wick, Edward Sabine, American engineer and patent expert: b. New York 3 Jan. 1823. He was graduated from Columbia in 1839 as a civil and mechanical engineer and became superintendent of large iron works at Wilkes-barre, Pa. In 1849 he began his career as a patent expert and in 1862, with his brother Henry Renwick, he repaired a break 82 feet long and 10 feet wide in the bilge of the Great Eastern while afloat, a feat deemed an impossibility by experts. He invented several machines and mechanical appliances and published 'Practical Invention' (1893).

Renwick, James, Scottish covenanter: b. Moniaive, Dumfriesshire, Scotland, 15 Feb. 1662; d. Edinburgh, 17 Feb. 1688. He was educated for the ministry at the University of Edinburgh, but upon declining to recognize Charles II. as the head of the Church was refused a degree. He finished his education at Groningen, Holland, was ordained in 1683, returned to Scotland, and engaged in preaching at conventicles. He was outlawed in 1684 as a result of publishing with Alexander Shields 'An Informatory Vindication of the Covenanters.' In 1687, as the acknowledged leader of the Cameronians, he was

put upon his head. He was captured in the following year and executed at Edinburgh.

Renwick, James, American scientist: b. Liverpool, England, 30 May 1790; d. New York 12 Jan. 1863. He came with his parents to New York in 1794, was graduated from Columbia and in 1812 acted as instructor in natural philosophy there. In 1814 he became a topographical engineer with rank as major in the United States service and in 1820-53 was professor of chemistry and physics at Columbia. In 1840 he was engaged as one of the commissioners to survey the boundary line between United States and New Brunswick. His publications include: 'Treatise on the Steam Engine' (1830); 'Outlines of Geology' (1838); 'Applications of the Science of Mechanics to Practical Purposes' (1840); 'Memoir of De Witt Clinton' (1840); etc.

Renwick, James, American architect: b. New York 3 Nov. 1818; d. there 23 June 1895. He was son of the preceding, and was graduated at Columbia College in 1836. Among his many works are Grace Church, New York, completed in 1845; the Smithsonian Institution and the Corcoran Art Gallery, Washington, D. C.; Vassar College, Poughkeepsie; and Saint Patrick's Cathedral, New York. This list of buildings evidences the versatility of this truly learned architect, whose mastery of French Gothic, both in its details and proportions, enabled him to give New York two of the noblest ecclesiastical exteriors in the city.

Repairs. See LAW OF LANDLORD AND TENANT.

Reparative Surgery. See SURGERY.

Repeal Movement, the agitation for the repeal of the Union between Great Britain and Ireland. This agitation commenced almost at the moment of the Union, and has continued to the present time. Robert Emmet sacrificed his life to the cause of repeal in 1803. But the word repeal is most intimately connected with the name and career of Daniel O'Connell, the Irish "Liberator." O'Connell died in 1847, and the cause of repeal was taken up by the Young Ireland party of 1848; by the Fenians, whose operations came to a head in 1865-7; and finally by the Home Rule party organized under the leadership first of Isaac Butt, in 1870, and later under the leadership of Charles S. Parnell. During the celebrated Parnell Commission of 1888-9, however, the Home Rule party, through their counsel, disclaimed all desire for repeal, maintaining that their aims were confined to the obtaining of Home Rule in the strict, or restricted, sense of the word.

Repeater, in arithmetic, an indeterminate decimal in which the same figures continually recur or are repeated. A pure repeater, or circulating decimal, is one in which the repetition goes on from the beginning; as, .3333 272727 A mixed repeater is one in which the repetition does not begin till after the intervention of a figure or figures; as, .128888 0113636, etc. (For the algebraic method of finding the value of a repeating decimal see PROGRESSION.)

In firearms, an arm which may be caused to fire several successive shots without reloading, whether rifle, pistol, or cannon. In horology, a watch or clock made to strike the time when a spring is pushed in. Some strike the hour and

REPENTANCE — REPRESENTATIVE GOVERNMENT

quarters, others the hour, quarter, and odd minutes. Nautically, a vessel, usually a frigate, appointed to attend each admiral in a fleet, and to repeat every signal he makes, with which she immediately sails to the ship for which it is intended, or the whole length of the fleet when the signal is general; called also a repeating ship. In telegraphy, the same as relay.

Repentance, or Contrition, as understood by divines, both Protestant and Catholic, is defined by the Council of Trent as "grief of mind and detestation of sin committed, with a purpose of sinning no more"; more specifically it is that sorrow for sin which arises out of consideration of God's goodness which sin has outraged, and which includes a resolution never more to offend God because God so deserves our love: this is the repentance called by Protestant divines "godly sorrow." The same Protestant divines recognize a second kind of repentance, which mourns that sin is attended by a penalty rather than hates sin. This differs little from the "attrition" of Catholic divines, which is an imperfect sorrow for sin arising from such motives as fear of hell, loss of heaven, the turpitude of sin.

Reporting. See JOURNALISM; NEWSPAPERS.

Repoussé, ré-poo-sā, a kind of ornamental metal work, formed in relief by striking on the metal from behind with a punch or hammer till the required forms are roughly produced in relief on the surface; the work is then finished by the process of chasing. The work of Benvenuto Cellini (1500-70), in this branch of art, is the most celebrated. Common work of this kind, as for tea or coffee pots, is executed in pewter and Britannia metal, and then electrotyped.

A piece of heavy cotton lace, or heavy open-work fabric, or a piece of a basket may be glued to a block of hard wood to serve as a sort of die for producing the impression in the metal. The fabric or basket work is not only attached to the block by means of glue, but its finer interstices are filled with glue, so as to present a surface resembling the original fabric only in the most general way. When the glue is perfectly dry and hard, the die is laid on a solid foundation, and a piece of very thin, soft copper or brass is secured to the block so as to cover the lace. A piece of cork about one fourth inch thick and about three inches wide and six or eight inches long is laid over the metal, and struck with a mallet. The cork yields sufficiently to push the metal down on the die, and cause it to take the pattern of the lace or whatever is used in forming the die. A piece of rather hard rubber packing will answer this purpose in nearly all respects as well as the cork.

Designs may be cut from strong paper or pasteboard and glued to the block, or a stencil design may be sawed from hard wood. The lines and scrolls are discontinued in places, so as to cause the wood to hold together. If it is desired to render the lines continuous at these points, they may be run through with a V-tool. Dots are picked out with a small gouge or the point of a revolving drill. In all these cases the metal is attached to the block and treated as above.

Either panels or continuous strips may be embossed in the manner described, and these are to be used in making frames, vases, and various ornamental objects. If the metal is too thin for a certain case, it may be strengthened by flowing

soft solder over the back of the plate by means of a soldering iron. As to finish, any of the several well-known methods of oxidizing or lacquering may be employed.

Bas-reliefs may easily be made by a method which is a modification of the one described. To a wooden frame is fitted a board, on which is drawn in outline the sign which is to be produced in relief. The board may be of pine or any close-grained, soft wood for lead work; but for brass or copper, the wood should be hard. To the frame is attached the plate of metal by means of screws. The board is removed from the frame, and the portion of the design which is to form the most prominent feature of the relief is sawed out of the board, when the latter is replaced in the frame, and the metal is forced into the opening of the board by pressing on the surface of the lead opposite the hole in the board, or by pounding it by means of the mallet. As soon as this feature is complete, the next in order is sawed out of the board, and the operation is repeated till all of the general features are developed. The progress of the work can be observed at any time by removing the board.

The features may be corrected or modified by working from either side of the plate by means of the convex mallet and the wooden punches and chisels. If a support is desired for any part while the work is progressing, a stout bag filled with sand may be placed under the part. A few very small bags, say 1 inch or 1½ inches, in diameter, will be found convenient. If desired, the drapery of the background may be chased by means of hard wood or metal punches, bearing the desired figures.

The relief, if of lead, looks well with an antique finish. This may be secured by rubbing the prominent portions of the relief with fine emery cloth, then going over the entire surface with a swab formed of a small roll of cotton cloth encircled by a coil of copper wire, the swab being dipped in dilute nitric acid before application to the relief.

The copper is dissolved and deposited on the bright prominent portions, while a dark deposit is made in the hollows, which when dry has a green tinge.

To give the work the appearance of antique iron the surface may be blackened by the application of a solution of sulphuret of potassium and the prominent portions may be semi-polished by briskly rubbing the entire surface with a piece of canvas or Brussels carpet.

Repplier, Agnes, American essayist: b. Philadelphia, Pa., 1 April 1855. She is of French descent, and was educated at the convent of the Sacred Heart, Torresdale. Her essays are characterized by lightness of touch, a keen sense of the humorous side of a theme, and not a little irony. She has published: 'Books and Men' (1888); 'Points of View' (1892); 'In the Dozy Hours' (1894); 'Essays in Idleness' (1893); 'Essays in Miniature' (1892); 'Varia' (1897); and 'Philadelphia: the Place and the People' (1898); 'The Fireside Sphinx' (1901). She has also compiled a 'Book of Famous Verse' (1892), and was a contributor to the 'Saturday Evening Post.'

Representative Government. Representative government in the modern meaning of the term was unknown to the ancients. Kings,

REPRESENTATIVES — REPROBATION

chiefs, and administrative officers were often elected by popular vote or acclamation, but neither in ancient Greece nor Rome did a body exist even remotely resembling a Congress, a Parliament, or a Reichstag. States which were not absolute despotisms were governed, as a rule, by a council of magistrates and a popular assembly, in which latter all persons with civic rights took part, and which was very much like a New England town meeting; but there is no instance of the popular assembly of ancient times developing into a representative body. The Roman Senate was composed of magistrates and ex-magistrates, and resembled the American Senate of to-day only in name. This ancient system, which appears from the standpoint of to-day both unwieldy and unruly, was well enough fitted, however, for the so-called republics in which it prevailed, and in which all power was reserved to the central city, whether Athens, Thebes, or Rome. The citizens in public assembly stood for the state, and were the state, and did not think it necessary to delegate their powers to representatives. When civic rule in Rome gave place to imperialism, the public assembly ceased to exist, while the senate was retained to register the decrees of the Caesars, and offer honorable retirement to those who had gained imperial favor.

Representative government, as we know it to-day, is not derived, therefore, from any Roman or Greek institution. It is essentially an outgrowth of that love of liberty inherent alike in Saxon and Norman, and reached its present development through centuries of struggle and of political and social evolution. The English Parliament, with its combination of mediæval House of Lords and 20th century House of Commons, has grown gradually from beginnings dating back almost to the Norman conquest. The barons asserted their rights against tyrannical kings, and the necessities of the kings compelled them to recognize the well-to-do classes outside the nobility, who had the wealth of which the royal exchequer stood badly in need. Taxation gave birth to representation, and at length it became a recognized principle that Englishmen would not stand taxation imposed without their own consent through representatives in Parliament assembled. It was not, however, until far into the 19th century that the common people of England were permitted to have a voice in public affairs, and not until 1885 that the suffrage was bestowed on virtually all male subjects of adult age in the United Kingdom. The Parliament of to-day therefore represents the English people; less than half a century ago it represented only the privileged classes.

Representative government in the United States inherited its spirit from England, but not its form. The American system is of native origin. It developed from town-meeting to assembly, and when the new States adopted new fundamental laws, the upper house was called a senate, after the ancient Rome senate, while the right of originating measures of taxation was reserved to the popular branch of the legislature. In the United States, also, however, the right or privilege of voting was generally restricted to taxpayers and property-owners for many years after independence, and in one of the States — Rhode Island — a landholding qualification for foreign-born citizens existed until

about 15 years ago. Excepting some peculiar restrictions intended to prevent negroes from voting in certain Southern States, nearly all male citizens of adult age now possess the right to vote.

In the Hanseatic towns, in Switzerland, the Italian free cities, and other republics of the Middle Ages, representative government had no real existence so far as the common people were concerned, and the parliaments of modern Europe are not derived from the institutions of those states. The American Revolution gave the impulse and inspiration needed to awaken the people of Europe to a sense of their rights and wrongs, and the constitutions granted by monarchs on the Continent to their subjects adopted as models a mixture of the English and American systems. With the exception of Turkey and Russia every European country has a congress or parliament in which the people are represented by deputies elected according to law. Japan has a similar system, and representative government which 100 years ago was practically confined to the United States and England, is now co-extensive with civilization in every continent. See GOVERNMENT.

Representatives, House of, the designation applied to that branch of the Congress of the United States elected directly by the people, and also applied in several States to the lower body of the State legislature. The Constitution of the United States vests in the House of Representatives the sole power to originate measures affecting taxation and finance, although the Senate has the right to amend such measures when passed in the Lower House, and it sometimes happens that a financial bill adopted by the House is virtually made a new measure in the Senate, and thus amended is accepted by the House, and becomes law. As tariff legislation is one form of taxation, it originates in the Committee on Ways and Means of the House, and the chairmanship of that committee is, therefore, a place of great power and importance. When the House and the Senate cannot agree, a Conference Committee is appointed from both bodies to adjust the differences, if possible. See CONGRESS OF THE UNITED STATES.

Reproaches, or Improperia (a Latin word of the same meaning), in the Roman Missal, a part of the divine service for Good Friday. While the clergy and people are paying veneration to the representation of the Crucified before the high altar, two pair of choristers chant alternately a series of antiphons, to which two choruses respond in versicles, Greek and Latin alternately, then repeating part of the antiphon. There are 12 Improperia, the first being: "My people, what have I done to thee? or wherein have I vexed thee? For that I led thee forth of the land of Egypt thou has provided a cross for thy Saviour." Again: "I lifted thee up with mighty power; and thou hast hanged me on the gibbet of the cross."

Reprobation, a dogma of the Calvinistic creeds, which teaches the predestination of some of the children of Adam to be eternally lost. Though the word reprobation is not used in the Westminster Confession of faith, the definitive reprobation of those who are not predestinated to everlasting life is unequivocally expressed in

REPRODUCTION

this passage of the Confession (iii. 7): "The rest of mankind"—that is, all but the elect to everlasting happiness—"God was pleased, according to the unsearchable counsel of his own will, whereby he extendeth or withholdeth mercy as he pleaseth, for the glory of his sovereign power over his creatures to pass by, and to ordain them to dishonour and wrath for their sin, to the praise of his glorious grace." Among the passages of the New Testament that are cited in support of this doctrine are Rom. ix. 11-22, 1 Thess. v. 9, 1 Pet. ii. 8, Jude 4.

Reproduction, among plants and animals, is, in a broad sense, the formation by any means of new persons or individuals to continue the life of the species. According to a more strict usage, reproduction is to be distinguished from propagation, which is generally confined to the production of new persons by the development of parts of some old individual, as for example, a branch of a tree, a polyp of a coral colony, or a portion of a certain species of worm. In all essential respects such a branch or polyp or worm-segment is an individual: the entire tree or coral-colony is considered to be a compound individual. The budding and branching of common plants and of many animals is really a production of new individuals. Single branches or twigs of almost all branching plants, cut off and planted under suitable conditions, will take root and become new individuals; the only difference between such an individual and a branch of a living tree is that in one case the new person and the old are separated, whereas in the latter the new individuals remain continuous with the old. Huxley used the terms *continuous growth* and *discontinuous growth* to designate these two conditions, the idea being that all the structures derived from a single egg constitute a single individual, whether continuous or not. According to this view all the weeping willows constitute collectively one individual, however many separate trees there may be, since this plant produces no seeds, being propagated by cuttings. The same would apply to other cultivated plants which have lost the habit of producing seeds. It is thus seen that propagation is but a development of growth; and all reproduction is a development of this property of protoplasm.

Propagation among Plants.—Among the unicellular plants, a common mode of multiplication is by *fission*, or the separation of the cell into two parts, each of which becomes an independent (though in many cases attached) individual, eventually to split up in its turn, and so on indefinitely. Among others (*Schizomycetes*), as the yeast plant, there is a process of *gemmation* or budding of the parent cell; the buds split off, or may remain attached, but really constitute independent units. Among the mosses, almost any part of the plant body will develop into a new individual when separated and placed under the proper conditions, and portions are frequently separated spontaneously for this purpose. The root-stock in ferns is a propagating organ, and the tip of the leaf in the walking fern will take root and produce an entire plant, while the part of the leaf connected with the old plant dies away. Some liverworts produce small masses of cells called gemmules which are thrown off and may develop into new plants. Among the flowering plants are found

many special means of propagation. The runner of the strawberry plant is a well known example; this is a prostrate branch which, at some distance from the parent plant, takes root, sending up a stem vertically, while the runner dies away; by this means one strawberry plant may extend itself in a single season over a large area. Some plants produce aerial bulbs, which are thrown off and may develop into new plants, as the onion. Underground stems, such as the tuber (as of potato), the root-stock. (as of iris), and the bulb (as of hyacinth), also serve for propagation, spontaneous or artificial. The leaves of many flowering plants, when separated from the parent stem, put forth adventitious roots and buds (such as arise in unusual places), which develop new plants. Begonia and byrophyllum are commonly propagated in this way. Many weeds are eradicated with great difficulty because of the fact that each piece into which the farmer's spade cuts the obnoxious plants grows into a new plant.

Propagation among Animals.—Among the *Protozoa*, multiplication by fission is the common method, though this is generally supplemented by occasional conjugation of two individuals. Among certain *Infusoria* budding also occurs. Among sponges, coelenterates and Bryozoa budding is the process that gives these animals their characteristic colonial formation. When an individual hydroid is mutilated by a portion being cut off, each part may proceed to develop what it lacks of being a complete individual. Among the echinoderms the starfish has the property of regeneration developed to such a remarkable degree, that a single ray of one may develop into an entire animal. Many flat-worms, round-worms and annelids have the faculty of letting each piece into which an individual may be cut up develop into a new individual, and some of them have the means and the habit of breaking up spontaneously. While many arthropods and even some vertebrates have the power to re-grow lost parts, in none of the higher groups of animals are there any capable of propagation by means of cuttings.

Reproduction Proper.—Reproduction proper is the multiplication by means of some structures specially formed for that purpose, and is of two kinds,—sexual and asexual. In asexual reproduction the bodies formed, called *spores*, are capable of developing directly into new individuals, while in sexual reproduction two reproductive bodies, called *gametes*, must first fuse together before development may begin.

Spores are produced by all plants except a few of the lower ones and such aberrant forms as have lost the habit of reproduction by special structures, and by certain of the lower animals. They consist usually of single cells having a thickened wall for protection against desiccation and other injury, and containing oil-drops or other stored-up nourishment. Plant spores are generally too small to be seen by the unaided eye, but in masses resemble so much dust, as seen in the pollen-dust of various flowers, in the dust of puff-balls, bracket-fungi, etc. Many *Algae* and *Sporozoa* produce spores that bear cilia which enable them to move about in the water; these are called zoöspores.

Spores are formed in three different ways: (1) By condensation of the protoplasmic content

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of some cell, with the formation of a special cell-wall (chlamydospores in *Mucor*, or the mass of protoplasm may escape and swim about for awhile by means of cilia, before forming a thick coat and passing through a resting stage. (2) By the splitting off of the end cells in filaments, singly or successively, these cells becoming spores, as in green-molds, red sea-weeds, puff-balls and mushrooms. (3) By the breaking up of the contents of special cells (spore-mother-cells) into few or many portions, each of which becomes a spore, as in black-mold, yeast, lichens, mosses, ferns and all spermatophytes. Animal spores are of this third type. A vegetable spore on germinating usually puts forth a delicate thread from which the plant of the next generation develops. In the lowest plants, as among the *Sporozoa*, the spore merely breaks out of its wall and changes directly into the next stage.

Sexual Reproduction.—Of sexual reproduction there are several degrees. The simplest form is *conjugation*, in which the two gametes are not only exactly alike, but are actually two entire individuals. This is well illustrated by the pond-scum and the various diatoms and desmids. Two individuals of some species of desmid will approach each other, and after coming in contact the cell-wall of each, on the side next its neighbor, will be dissolved and the protoplasm from the two cells will flow out and the two masses fuse into one, which, after forming a thick wall and resting for a period, will become a new free-moving individual. Essentially the same method is seen in black-mold and in other plants, while in *Spirogyra* the contents of one cell passes over into the other cell, where the two masses fuse. The product of the conjugation of two gametes which are, as in the cases given, essentially alike, is called a zygote; but among the lowest classes of plants and animals there already arises a differentiation between the gametes into the male *spermatozoon* (or antherozoid), and the female ovum. The process of fusion of the two differentiated gametes is called fertilization or fecundation of the egg or ovum, and the product is known as the fertilized ovum.

Alternation of Generations.—Among the liver-worts, mosses, ferns and phanerogams, as well as among certain groups of animals, there is found the phenomenon known as "alternation of generations," called by Spencer *heterogenesis*. The sporophyte, or that stage in the life-history of the plant which produces spores, does not at all resemble the gametophyte, or gamete-producing generation; moreover, the spores develop only into gametophytes, while the fertilized eggs develop only into sporophytes, thus bringing about an alternation of the sexual generation with the asexual generation.

The ordinary green plant of a liverwort or a moss is the gametophyte, producing archegonia in which the ova are formed, and antheridia in which antherozoids are formed. The antherozoids are discharged into the water and find their way into the archegonia, and fertilize the eggs in these. From the egg the sporophyte develops directly, being in the case of the mosses the "capsule" with its stalk. In the capsule the spores are produced, and after being thrown out each of these may germinate and develop into a gametophyte. In the ferns, the familiar

stage is the sporophyte; the spores, produced in groups of spore-cases or sporangia on the under surface of the leaves, or on special modified leaves, may develop, under suitable conditions, the sexual generation, or prothallium, which is a very inconspicuous, heart-shaped plate of cells, rarely over one fourth inch in diameter, bearing archegonia and antheridia on its under surface; after fecundation, the egg develops into the familiar sporophyte.

Among some of the ferns, and in all of the higher plants, two kinds of spores are formed; a large spore, the gametophyte developing from which produces only female gametes; and a small spore resulting in a gametophyte producing only male gametes. Among the flowering plants the difference between the sexual and the asexual generations is so great that one of them is very commonly entirely overlooked, even in such well known text-books as Gray's. All the trees, flowering shrubs and herbs, grasses, etc., are sporophytes, and the two kinds of spores are the pollen and the embryo-sac of the ovary. In these highest plants the male gametophyte is reduced to the pollen tube, which grows down from the stigma, into proximity of the ovule. The female gamete is still farther reduced. The male gamete is a special portion of the protoplasm in the end of the pollen-tube, while the female gamete is a special portion of the protoplasm in the embryo-sac. It is to be noted that whereas in the mosses and liverworts the sporophyte derives the bulk of its nutrition from the gametophyte, among the phanerogams the male and female gametophytes are parasitic upon the sporophyte, which does all the vegetative work. After fertilization the embryo of a new sporophyte generation is developed at the expense of the preceding sporophytic generation. This embryo is the essential part of the seed. The popular reference to seeds as reproductive organs or structures, and to the anthers and ovaries of flowers as respectively male and female, is manifestly false.

Purpose of Reproduction.—Reproduction of organisms seems to be an outcome of the fact that conditions of life are variable; for various reasons immortality of the individual is impossible, and continuation of the life of the species can therefore be secured only by multiplication of individuals. This theory is in harmony with the observed periodicity of the reproductive processes, as well as with the fact that the reproductive processes may be hastened or retarded by artificial control of the conditions. See ANATOMY; ANATOMY, COMPARATIVE; EMBRYOLOGY; SEX.

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REPRODUCTIVE ORGANS — REPTILES

Reproductive Organs. See ANATOMY, COMPARATIVE.

Reptiles, or Reptilia, a class of vertebrated animals. Although no two groups of *Vertebrata* are more dissimilar in general appearance and habits, and to the popular mind might seem more unrelated than the birds and reptiles, they are, by common consent of modern systematists, combined in a superclass, the *Sauropsida*, of Huxley, or the *Monocondylia*, of Haeckel and Cope. The *Sauropsida* are distinguished by the possession of lungs, gills being permanently absent. The embryo possesses an amnion and allantois, the former being a sac investing the body, the latter a structure developed from the lower surface of the embryo, and serving for respiration. The lower jaw in *Sauropsida* is compound in that each half or ramus consists of a number of distinct pieces; while in mammals each half consists of but a single piece. The lower jaw in reptiles and birds further articulates with the skull, not directly, but through the intervention of a separate and distinct bone, the os quadratum or quadrate bone. The skull is joined to the spine by one condyle only, borne on the occipital or hinder bone of the skull; two such condyles exist in amphibians and mammals. As compared with the fishes and batrachians the basal axis of the brain-case is bony instead of cartilaginous and the parasphenoid bone is absent. The bodies of the vertebræ are formed chiefly of centra (that is, are gastrocentrous) instead of intercentra (notocentrous) as in the *Amphibia*. Very rarely and only in extinct forms is the notochord persistent. The ankle-joint is placed in *Sauropsida*, not as in mammals, between the tibia and the astragalus, but between the proximal and distal parts of the tarsus which in *Sauropsida* becomes thus divided. The coracoid bone is almost always well developed. The intestine ends in a cloaca. No complete diaphragm is developed to separate the thorax from the abdominal cavity. The corpus callosum uniting the halves or hemispheres of the cerebrum is rudimentary, no mammary glands exist, and the *Sauropsida* are oviparous or ovo-viviparous. The red blood-corpuscles are oval and nucleated. Such are the characters common to birds and reptiles.

Reptiles differ from birds in the following characters, which may therefore be taken as including the definition of the class Reptilia. The exoskeleton consists of horny scales or of bony plates (scutes), but never of feathers. The blood is cold, and two aortic arches (right and left) exist in living *Reptilia*. The heart is three-chambered in all save the crocodiles, which possess a four-chambered heart. But in all reptiles, without exception, the venous and arterial currents of blood are connected, and an impure or mixed blood is thus circulated throughout the body. The lungs do not present the open character of those of birds, but, like those of mammalia, are in modern reptiles almost always closed sacs. The tarsal and metatarsal bones of the hind limbs, which in birds are united to form a single bone, are distinct and separate in the great majority of reptiles. When a sacrum exists it bears sacral ribs, which articulate with the ilia or haunch-bones.

The body in reptiles is generally elongated, the tortoises and their allies presenting the

most notable exceptions to this rule. The limbs may be entirely wanting, as in most snakes and in many lizards; or only a pair of limbs may be developed, as in some lizards; while in most other reptiles all four members are present. The exoskeleton varies greatly in its development throughout the class. As in the tortoises and turtles and crocodiles it may attain, either separately or in combination with the endoskeleton, a high development, with superficial deposits of bone. In serpents and many lizards it is moderately developed and chiefly horny, while in some lizards the skin is comparatively unprotected. The bones of reptiles are more compact than those of lower vertebrates, and it is also notable that in reptiles the sutures, or lines of union between various bones, have a degree of persistence beyond that in other classes of the phylum. In the reptilian skeleton the five different regions into which the spine is ordinarily divided are to be recognized, except in the serpents and a few others. There are seldom more than two sacral vertebræ, and free cervical ribs are usually present. The epiphysal and other sutures of the vertebræ are retained through life. The bones of the shoulder-girdle of each side include a simple or divided scapula or shoulder-blade and an often complex coracoid bone, including precoracoid and epicoracoid, the latter bone of each side articulating with the sternum or breast-bone when the latter is present. In addition a clavicle and interclavicle may be present. The fore-limbs consist each of a humerus, radius, and ulna, the carpal bones, and normally five digits. The pelvis contains its three typical elements, ilium, ischium, and pubis, the first being often of larger size and the last usually forming a symphysis. In serpents the shoulder-girdle is totally absent and vestiges of the pelvic-girdle appear only in a few instances; and in the turtles both are enclosed within the shell, except that the clavicle and interclavicle form part of the plastron. The limbs are usually adapted for running, but sometimes for leaping and in the extinct pterodactyls for flight. In the extinct marine pelagic reptiles, and in the modern sea-turtles, they are paddle-like. The ribs in reptiles are always present, but may differ greatly in form and disposition, those of the turtles, for example, contributing toward the formation of the upper shell or carapace.

The skull of *Reptilia* possesses but a single occipital condyle, by means of which it articulates with the spine. This condyle is formed by the basi-occipital and ex-occipital elements of the cranium and is sometimes tripartite. The quadrate bone is generally firmly fixed to the skull, joining the squamosal bone above, but is freely movable in serpents and only less so in many lizards. Each half or ramus of the lower jaw is composed of dentary, angular, surangular, coronoid, splenial, and articular bones. Other regions of the skull are modified in the greatest varieties of ways in the several orders, the most important from a systematic standpoint being in the bones which form the complex roof of the temporal fossa. Primitively this roof is complete as in the stegocephalian batrachians, but by the formation of one or two openings (supra- and infra-temporal vacuities) it is divided into one (*Synapsida*) or two (*Diapsida*)

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longitudinal bars behind the orbits. Through variations in the size and position of these openings, to which may be added emarginations, this region is modified, and may even practically disappear altogether, as in the snakes.

The teeth are generally well developed, but in the *Chelonia* are wanting, the jaws, like those of birds, being ensheathed in horn. The reptilian teeth, like those of lower *Vertebrata* generally, are adapted less for mastication than for merely retaining prey while it is being swallowed. Save in the crocodiles and in some extinct forms the teeth are not implanted in sockets or *alveoli*, but are attached in various ways and by bony union to the jaw-bones. Teeth may be borne by bones other than the jaws (for example, palate bones); and, as seen in the poison-fangs of serpents, may be modified for special purposes. The teeth vary greatly in number and are not persistent, new teeth being produced in regular order (as in crocodiles) from a growing pulp at the base of the socket, the new tooth displacing the old.

The tongue may be elongated, distensible, and bifid, as in many lizards and serpents; short, thick, and non-protrusible, as in other lizards; or completely attached and fixed throughout its entire extent, as in *Crocodylia*. The œsophagus or gullet is usually greatly distensible (as in serpents), and may be covered (as in some *Chelonia*) with retroverted spines. The stomach is mostly pyriform or pear-shaped, and (as in snakes) may, like the gullet, be capable of great distension. In *Ophidia* it exhibits an anterior dilated part, with thin walls for receiving nutriment, and a posterior hinder portion with non-distensible walls provided with glands, and adapted for digesting the food. In the crocodile the stomach resembles the gizzard of a grain-eating bird in its high muscularity.

The heart in reptiles consists of two auricles (right and left) and a ventricle, except in the *Crocodylia*, in which two auricles and two ventricles are developed. Two aortæ or main arterial trunks exist, and are respectively named right and left aortæ. These chief vessels bend round the gullet, and unite to form a single and common main-trunk for the supply of blood to the system generally. But the chief peculiarity in the circulation of all reptiles consists in the peculiar mixture of arterial with venous blood, which takes place in the aorta in such a manner that the head alone is supplied with arterial blood. Although the latter forms possess a four-chambered heart, the circulation is functionally and essentially the same as in other *Reptilia*. It therefore follows that the body in *Reptilia* is nourished by an impure or mixed blood. The reptiles exhibit sluggish habits, slow respiration, and a series of vital actions marked by no active conditions demanding a more perfect circulation or highly-oxygenated blood. The blood is cold (poikilothermic) in reptiles, that is, is but little higher in temperature than the surrounding medium, with changes in which it varies. The red blood-corpuscles are oval and nucleated.

Respiration in reptiles is carried on solely by means of lungs, the presence of branchiæ or gills in early life, and sometimes in the adult life also of batrachians, constituting a marked difference between these latter and reptilian

forms. In the *Crocodylia*, *Chelonia*, and most lizards, the lungs are equally developed, but in serpents and some lizards only one lung is fully developed, the right lung being usually abortive. The lungs may, as in snakes and other *Reptilia*, in which the body is elongated, be of proportionally large size, and may extend nearly throughout the whole length of the body cavity which is not separated by a complete diaphragm into a distinct thorax and abdomen. In the crocodiles, lizards, and serpents the respiratory action is carried on through movements of the walls of the trunks. But in turtles, in which no movements can take place, air is drawn into the lungs by a process analogous to swallowing. The larynx or organ of voice is simple in structure, no vocal cords being in general developed, although these organs appear in crocodiles and some others.

In the higher *Reptilia* the cerebrum attains a comparatively larger size than in the lower forms, while the cerebellum also attains a relatively higher development as we proceed upward. The cerebellum has no lateral lobes nor pons, while the corpora bigemina and thalami are of large size. The senses are developed in tolerable perfection. The nasal cavities are of large size, and open into the mouth through either the anterior or posterior part of the palate. In the *Crocodylia* the hinder nostrils open very far back in the mouth, enabling these animals to hold their prey under water in their mouths, and so to drown it, while their own respiration is carried on unimpeded through the nostrils. The eyes are usually of small size, and exhibit variations in structure and in the disposition of the protective coverings. Thus in snakes the eye-ball in front is covered by a transparent lid, formed by a layer of the skin, which is attached to a circle of surrounding scales, and is shed periodically, with the outer skin. In snakes the pupil of the eye is round. In the lizards movable and ordinary eyelids exist, while the turtles possess a nictitating membrane. In lizards and snakes the sclerotic coat of the eye is strengthened by a circle of bony plates, such as also occur in several extinct reptilian forms and in birds. In the chameleons the single eyelid is formed by the united lids, and through an opening in this circular lid the rays of light enter the pupil of the eye within. The tympanum of the ear is imperfectly developed in *Ophidia*, and no eustachian tube exists. In lizards the tympanic apparatus is better developed, while in chelonians the tympanic cavity is large and complicated, and a rudimentary cochlea exists. The *Crocodylia* possess a movable valve, by means of which the tympanic canal of each ear can be closed at will; and most of the structures found in the ear of higher *Vertebrata* are represented in greater or less structural detail and perfection.

The kidneys are generally placed far back and deep within the pelvic cavity. In the serpents, however, the kidneys are situated anteriorly, and are unsymmetrically placed, the right being placed higher up and in advance of the left kidney, while they are divided into small lobes. No urinary bladder exists, and the urine of the lizards is fluid, that of the serpents resembling the excrement of birds in being pasty and crystalline. In *Crocodylia* the testes are elongated, and placed in front of the kid-

neys. The penis in *Crocodylia* is single, grooved and contained within a special cloacal fold; in *Ophidia* two lateral penes exist, and these are hollow and evertible; and a double penis exists in lizards, while that of turtles is single.

The eggs are generally of relatively large size, and provided with a thick parchment-like shell and a large yolk. In many instances the eggs may be deposited in sand, and be hatched by the sun's heat.

With regard to the distribution in space of reptiles, the warm or tropical regions of the earth contain these animals not only in greatest number, but in most typical form and variety. During winter, or in the colder seasons of the year, most reptiles hibernate, and many desert species also pass into a summer sleep. Reptiles are varied in their habits, most of them being terrestrial, but many arboreal and some, including the great majority of the turtles, are aquatic. While most are strictly carnivorous or insectivorous, some subsist on a general diet and a few are purely vegetarian. Many of the extinct forms fed exclusively on fishes. Reptiles exhibit many interesting habits, but, owing to a popular prejudice against them, and the tax on the patience of the observer resulting from their inactivity and secretiveness, they have been comparatively little studied.

Because of certain resemblances in form and manners, all of the early zoologists, to and including Cuvier, classed the *Reptilia* and *Amphibia* together, and it was only when embryological data began to play an important part in taxonomy that their dissimilarity was perceived. Milne-Edwards and his contemporaries toward the middle of the 19th century were the first to recognize this in a scheme of classification. In 1860-70 when zoologists were still working under the fresh stimulus of the publication of the 'Origin of Species,' Huxley, Haeckel, and Cope almost simultaneously perceived much more clearly than had any of their predecessors the close relationship and probable community of descent of birds and reptiles. Reptilian life played a so much more important role in past ages of the earth than now, that it is not surprising that we must turn to palæontologists for nearly all of the recent advances in the classification of the groups. The scheme and nomenclature mainly followed in this work is that elaborated by Gadow in Vol. VIII. of the 'Cambridge Natural History.'

CLASS REPTILIA.

Subclass *Proreptilia*.

Subclass *Prosauria*. Orders: Microsauri, Prosauri (Rhynchocephalia, etc.).

Subclass *Theromorpha*. Orders: Pareiasauri, Theriodontia, Placodontia, Anomodontia.

Subclass *Chelonina* (Turtles). Orders: Atheca, Thecophora.

Subclass *Dinosauria* (Dinosaurs). Orders: Sauropoda, Theropoda, Orthopoda, Ceratopsia.

Subclass *Crocodylia* (Crocodylians). Orders: Pseudosuchia, Parasuchia, Eusuchia.

Subclass *Plesiosauria*. Orders: Nothosauri, Plesiosauri.

Subclass *Ichthyosauria*. Orders: Ichthyosauri (Fish-lizards).

Subclass *Pterosauria* (Flying Reptiles). Order: Pterosauri (Pterodactyls).

Subclass *Pythonomorpha*. Orders: Dolichosauri, Mosasauri.

Subclass *Sauria*. Orders: Lacertilia (Lizards); Ophidia (Serpents).

A more elaborate scheme, but one which more correctly expresses the natural relationships of the orders, has been developed by Cope, Baur, and Osborn.

The vast majority of reptilian types have become extinct. Only four orders are represented in our modern fauna, and one of these, the *Rhynchocephalia*, by only a single species, the New Zealand tuatara (q.v.). The *Crocodylia* have greatly declined in variety of forms since the close of the Mesozoic Age. The *Pythonomorpha* have become extinct, but lizards and snakes are represented in the saurian orders by a great number of species, and are the only dominant reptilian types. Reptiles flourished especially during the Mesozoic Age, to which four of the most remarkable groups were confined, the great marine reptiles (*Plesiosauria* and *Ichthyosauria*), the huge and often remarkably modified terrestrial *Dinosauria*, and the equally wonderful flying *Pterosauria*. This epoch, when the seas were shrinking and dry land increasing in extent, but when the atmosphere was heavy with moisture and carbonic-acid gas, unfitted for the respiration of high types of life, was well suited for the development of the sluggish reptiles; and they were dominant on land and sea, replacing on the one hand the amphibians and on the other the primitive types of fishes of earlier ages. With the close of the Age of Reptiles and the advent of the Eocene Period, mammals quickly rose to full dominance on the land, and many orders of reptiles, having played their parts in the evolution of life, disappeared forever. Reptiles sprang from the stegocephalian *Amphibia*. From some group of the *Theromorpha* (of the synapsidan series) mammals are supposed to have come; while birds took their origin from the diapsidan line, probably in common with some primitive dinosaurian.

Consult, besides the numerous articles in this work on special orders and kinds of reptiles, the following: Cope, 'The Crocodylians, Lizards, and Snakes of North America,' Rep. U. S. Nat. Mus. (Washington, 1900); Holbrook, 'North American Herpetology' (Philadelphia, 1842); Gadow, 'Amphibia and Reptiles' (New York, 1901); Boulenger, 'Catalogue of the Reptiles in the British Museum' (London, 1889-96); Osborn, 'The Reptilian Subclasses Diapsida and Synapsida,' Memoirs Amer. Mus. Nat. Hist. (New York, 1903); Woodward, 'Vertebrate Palæontology' (Cambridge, 1898).

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Rep'ton, a village of Derbyshire, England, about seven miles from Derby; it was once an episcopal see and capital of the kingdom of Mercia, and had a celebrated nunnery from 660 till its destruction by the Northmen in 874. From 1172 till the dissolution of the monasteries under Henry VIII. it was the seat of a priory of Austin friars; part of the priory buildings is incorporated in the fabric of the Repton free grammar school, founded in 1556, one of the great English public schools. The parish church is notable for its curious crypt, consisting of a centre and side aisles divided by three arches on either side.

REPUBLIC—REPUBLICAN PARTY

Republic, a word signifying a state in which the people are the source of power. The degree of popular sovereignty in republics has varied very widely in the past, most of the so-called republics having been ruled by an aristocracy which jealously guarded its own rights, but treated the multitude as little better than slaves. Real republican government may be said to date from the American Declaration of Independence, and even in the United States the government was largely one of class until about the second quarter of the 19th century, when suffrage barriers began to break down. The other so-called American republics are mostly military despotisms, in which order or disorder is maintained by force under the command of a successful general. Argentina is an exception to this rule, and Chile and Brazil are also gradually becoming inspired by the real republican spirit, while Cuba, the youngest of American republics except Panama, which has just been admitted to the family of nations, is making an excellent record. In Mexico the strong hand of Porfirio Diaz has lifted that rich republic from a chaotic, almost barbarous condition to a reign of law and order, progress and prosperity.

As an instance of the way in which the term "republic" was used or abused in the past, it may be mentioned that Poland was formerly called a republic because the king was elected by the nobles; and in the 18th century it was not uncommon to designate the German empire by the appellation of the "republic of princes." The large commercial cities of Italy, Genoa, and Venice were called republics because they were governed by an aristocracy of noble families, who appointed one of their number to be supreme chief of the state, as the *doge*. The republican institutions of the greater part of the Greek states, as well as that of Rome, at least in later times, were of a more democratic character. The first republic of any great extent in modern Europe was the confederation of the seven provinces constituting the Dutch Republic, after their separation from Spain, and which continued until the year 1815, when it became a hereditary monarchy. Switzerland became a republic after having freed itself from German rule. Great Britain was nominally a republic for 11 years, from 1649 to 1660, as also was France from 1793 to 1804. France again assumed a republican constitution in 1848, which, however, only lasted till 1852. But on the 4th of September 1870 a republic was established in France for the third time in its history, and it is likely to continue to exist. The republics created in Hungary, Italy, Baden, and Rhenish Bavaria after the revolutionary movements of 1848 were all very ephemeral. Spain possessed a republican government twice in the course of somewhat recent years—in 1868-9 and in 1873-4. Besides the quasi-republican cities of Germany—Bremen, Hamburg, and Lübeck—and the diminutive republics of San Marino, in Italy, and Andorra, the only republics in Europe at the present day are those of Switzerland and France. In the New World, on the other hand, the republican form of government prevails universally among the independent states, the most important of all the republics there being, of course, the United States.

Of the tiny republics of the world San Ma-

rino is the best known. It is situated in central Italy, and its territory covers about 33 square miles and the population numbers about 8,500 souls. This miniature state was founded in the 4th century by Saint Marinus, who, having embraced Christianity, fled there to escape the persecution under Diocletian. The capital, San Marino, is on the crest of a mountain over 2,000 feet high and has a population of 1,200. It is one of the most picturesque places in the world, being perched on perpendicular cliffs.

The small half French and half Spanish republic of Andorra, which lies in an almost inaccessible valley of the eastern Pyrenees, possesses a charter of rights dating from Charlemagne in 790. There is but one way of getting to Andorra from France and that is by the river Bolira. To reach it from Spain one has to be carried down by mule over one of the most dangerous footpaths in Europe. There are six parishes in the republic, and the whole contains about 6,000 people, the territory covering an area of 148 square miles.

Republican, the river which unites with Smoky Hill River, at Junction City, Kan., to form the Kansas River. The Republican is formed by two streams which unite in east central Colorado. The river flows northeast into Nebraska, then east and southwest, entering Kansas at Superior in Jewell County, continuing south, east, and southeast to the Kansas River.

Republican Party, The. The Republican Party was an inevitable outgrowth of the conditions which prevailed about the time of the repeal of the Missouri Compromise in 1854. The Whigs, incapable of grappling with new problems, were rapidly disintegrating; no one of the sporadic parties sprouting in the political confusion of the time was based on broad enough principles to become a truly national organization; the Republican Party, germinating in the Free Soil movement and inheriting Whig and Federalist traditions, happily combined the inspiration of a great moral principle, with the enduring quality of sane policies in Federal administration. Its origin cannot properly be ascribed to any particular date or place. The first known suggestion of the name was in a letter written by Horace Greeley. The earliest convention of importance to adopt it was held at Jackson, Mich., 6 July 1854. Virtually coincident with the Michigan convention there were conventions in Maine, Illinois, Massachusetts, Ohio, Indiana, Wisconsin, and Iowa; almost spontaneously the Republican Party had become a strong national organization. On the roster of the 33d Congress, the name "Republican" does not appear; in the 34th Congress, which met 3 Dec. 1855, there were in the Senate 15 Republicans, 42 Democrats and 5 Americans; in the House of Representatives there were 108 Republicans, 83 Democrats, and 45 Americans. The Whigs had disappeared. Nathaniel P. Banks, of Massachusetts, was chosen Speaker of the House by a combination of Republicans and Americans, after a memorable contest.

Steps were taken at once to put a ticket in the field for the approaching election of President. The chairmen of the state committees of Maine, Vermont, Massachusetts, New York, Pennsylvania, Ohio, Michigan, Indiana, and Wisconsin called an informal convention

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to meet at Pittsburg 22 Feb. 1856. A committee appointed at that meeting called a national convention to meet at Philadelphia 17 June 1856 to nominate candidates for President and Vice-President. The call was addressed to "the people of the United States, without regard to past political differences or divisions, who are opposed to the repeal of the Missouri Compromise, to the policy of the present administration, to the extension of slavery into the territories, in favor of the admission of Kansas as a free State, and of restoring the action of the Federal government to the principles of Washington and Jefferson". John C. Frémont, of California, was nominated for President, and William L. Dayton, of New Jersey, for Vice-President, on a platform, the most conspicuous plank of which read as follows:—

Resolved, That the Constitution confers upon Congress sovereign power over the territories of the United States for their government and that in the exercise of this power it is both the right and the imperative duty of Congress to prohibit in the territories those twin relics of barbarism, polygamy, and slavery.

It was essentially a one-idea convention, although resolutions were adopted favoring national aid for a railway to the Pacific coast, and liberal appropriations for rivers and harbors; but the party was not long to remain thus limited in its mission. The convention of 1860, which nominated Abraham Lincoln for President, adopted resolutions which committed the new party to the doctrine of a protective tariff, in the following clause:—

That, while providing revenue for the support of the general government by duties upon imports, sound policy requires such an adjustment of these imposts as to encourage the development of the industrial interests of the whole country; and we commend that policy of national exchanges which secures to the workmen liberal wages, to agriculture remunerative prices, to mechanics and manufacturers an adequate reward for their skill, labor, and enterprise, and to the Nation commercial prosperity and independence.

The Republican Party is thus seen almost from the beginning to have been committed to the protective policy which remains to-day one of its great principles. The election of 1856 resulted in a Democratic victory. James Buchanan received 174 electoral votes; Frémont received 114. It is perhaps fortunate that the new party did not then meet with success. Their candidate was a popular hero. No better name could have been selected about which to rally a new party devoted to a moral idea. Had the party been successful in 1856, however, the War of the Rebellion would doubtless have begun then, and Frémont by temperament and experience was ill-fitted to grapple with such a problem. The inspiration of the campaign which he led carried the Republican Party up to the momentous success of 1860. When the clouds broke, Abraham Lincoln was at the head of the state endowed beyond all other men of his time with the ability to cope with such a storm. The National Convention at Chicago, 16–18 May 1860, nominated Abraham Lincoln, of Illinois, for President, and Hannibal Hamlin, of Maine, for Vice-President. In the election which followed Lincoln and Hamlin received 180 electoral votes; all others received 123 electoral votes. In April immediately following Lincoln's inauguration, Fort Sumter was fired upon and the Civil War began. The war occupied the four years of Lincoln's administration. The Republican Party was not only charged with

the heavy work of administration, but it was responsible for the preservation of the government. When it entered upon the war, the government was without military preparation. Congress and the President were compelled to build navies, raise armies, to provide money, and to fight the battles of the Republic. In the midst of the war, on 1 Jan. 1863, the proclamation of emancipation went into effect. An election for President was held near the end of the war, in November 1864. The Democratic Party nominated General George B. McClellan, of New Jersey, for President, and George H. Pendleton, of Ohio, for Vice-President. The principal plank of its platform was a blunt declaration that the war was a failure. The Republicans at Baltimore, 7 June 1864, renominated Lincoln for President, with Andrew Johnson, of Tennessee, for Vice-President. During the early days of the campaign, even Lincoln believed the Republican ticket would be defeated at the polls, and he began preparations for a Democratic successor; but Lincoln received the electoral vote of every State not in the rebellion except Kentucky, Delaware and New Jersey—212 electoral votes; McClellan received 21.

The assassination of Lincoln, 14 April 1865, was a calamity not only to the country but also to the Republican Party, upon which was pressing at the moment the problem of reconstruction growing out of the Civil War. Lincoln had the qualities needed at that time—firmness, moderation, and political sagacity. Andrew Johnson, who succeeded to the Presidency, was ill-fitted either by temperament or by training to deal with the delicate questions which then arose. He was hot-headed, uninformed, and unbalanced in judgment. He was soon at odds with the leaders of his party in Congress, and by his obstinacy drove them to extremes which might have been avoided had the Executive been guided by a broader intelligence. All the measures of reconstruction were forced through in spite of the President's opposition. The differences became so marked that in February, 1868, articles of impeachment were brought against the President by the House of Representatives. In the impeachment proceedings in the Senate the President was not convicted. The vote was: Guilty, 35; not guilty, 19,—one less than the two thirds majority required by the Constitution for conviction.

Ulysses S. Grant, of Illinois, was the unanimous choice of the Republican National Convention, which met at Chicago 20–21 May 1868. Schuyler Colfax, of Indiana, was the candidate for Vice-President. In the election which followed, Grant and Colfax received 214 electoral votes. Seymour and Blair, the Democratic candidates, received 80. Throughout Grant's first administration, both Senate and House were strongly Republican. The 15th amendment to the Constitution having been recommended by Congress and adopted by the States, was proclaimed on 30 March 1870. To Grant fell the task of bringing the Southern States, lately in rebellion, into adjustment with the reconstructed Union. The problems of his first administration were largely those which grew out of this new relationship. The former slaves in Southern States exercised for the first time their newly acquired privilege of voting. The state governments of negroes and carpet-baggers which were set up became a scandal. The outrages com-

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mitted by Southern Democrats upon all Republicans of whatever color aroused the resentment of the North, and kept the South in a condition of disorder which necessitated constant Federal interference.

The situation in the South, coupled with differences between the administration and certain Republican leaders, conspicuous among whom were Charles Sumner and Horace Greeley, caused a defection in the Republican ranks. The discontented Republicans met at Cincinnati in May, 1872, and nominated Horace Greeley, of New York, for President, and B. Gratz Brown, of Missouri, for Vice-President. The platform declared that sectional issues should be buried, that civil service reform should be inaugurated and that specie payment should be immediately resumed. The Democratic convention at Baltimore in July accepted the Liberal Republican candidates and platform. The regular Republican convention at Philadelphia, 5-6 June, re-nominated Gen. Grant for President by acclamation, and put Henry Wilson, of Massachusetts, on the ticket with him. Grant and Wilson received 286 electoral votes out of 366.

The first two years of Grant's second administration witnessed a strong reaction against the Republican party. There was a financial panic in 1872 and 1873, and the scandals of the whiskey ring in the Treasury Department, and of the post traderships in the War Department, involving men who were regarded as close to the administration, created a strong feeling throughout the country. The general dissatisfaction resulted in a political overturn in 1874. For the first time since 1860 the House of Representatives in the 44th Congress contained a Democratic majority.

By the time the Presidential election of 1876 arrived the Republican Party had regained much of the ground it had lost. Rutherford B. Hayes, of Ohio, was nominated for President in the convention at Cincinnati 14-16 June 1876. William A. Wheeler, of New York, was nominated for Vice-President. The Democratic candidates, nominated at Saint Louis, were Samuel J. Tilden, of New York, and Thomas A. Hendricks, of Indiana. The Democrats went into the campaign with a cry of "Turn the rascals out." In the election which followed Tilden and Hendricks received a majority of the popular vote. There was a dispute in regard to the electoral votes of South Carolina, Florida, Louisiana, and Oregon. The disputed votes were finally referred to an Electoral Commission, composed of five Senators, five Representatives, and five Justices of the Supreme Court. After a long hearing, during which the country was in great excitement, the Commission awarded all the contested votes to Hayes and Wheeler, and they were declared elected, receiving 185 electoral votes. Tilden and Hendricks received 184 votes. The administration of President Hayes is notable for two reasons. He withdrew Federal troops from the South, thus leaving the negro voters at the mercy of the white population. The Southern States, which had been Republican up to 1876, now passed under Democratic control, and have remained Democratic with only occasional exceptions, ever since. Under the administration of John Sherman, as Secretary of the Treasury, specie payments were resumed and the finances of the government were fixed firmly on a substantial foundation. President Hayes had

to deal with a Democratic House of Representatives throughout his term.

In the election of 1880, James A. Garfield, of Ohio, and Chester A. Arthur, of New York, nominated at Chicago 2-8 June, were chosen President and Vice-President respectively, receiving 214 votes against 155 electoral votes cast for Hancock and English. They also received a plurality of the popular vote. For the first time since 1874 the Republicans controlled the House of Representatives. The Senate was evenly divided. President Garfield was shot on 2 July 1881, and died on 19 September, leaving the administration in the hands of President Arthur. During Arthur's administration the Civil Service Commission, was created and the first steps were taken to divorce the great body of subordinate offices in the civil service from the changes incident to party politics. Under the administration of William E. Chandler, as Secretary of the Navy, the building of the new navy was begun. A treaty was negotiated with the government of Nicaragua, looking to the construction of an inter-oceanic canal. This treaty had not been ratified by the Senate when the administration came to an end, and President Cleveland promptly withdrew it upon entering the White House. The administrations of Garfield and Arthur were marked by factional differences in the Republican Party. The elections for Congress in 1882 resulted adversely, and in the 48th Congress there was a Democratic majority of 73. Grover Cleveland was elected Governor of New York by a majority of nearly 200,000 over Secretary Folger, who had been nominated for Governor through administration influence. In the election of 1884, Blaine and Logan, the Republican candidates for President and Vice-President—nominated at Chicago 3-6 June—were defeated by Cleveland and Hendricks, the Democratic candidates, receiving 182 electoral votes as compared with 219 for their opponents. The campaign was fought almost solely on the personality of Mr. Blaine, and has never been excelled for bitterness. The result was determined by a plurality of 1,149 in a total vote of 1,200,000 in the State of New York. The Democrats controlled the House throughout the Cleveland administration, but the Republicans had a majority in the Senate, which prevented affirmative legislation of any consequence. President Cleveland brought the tariff question sharply to the front in his message of 1887, and the agitation which grew out of that message resulted in a campaign fought on the tariff issue in 1888. The Republicans in that year, in a convention at Chicago, 19-25 June, nominated Benjamin Harrison, of Indiana, for President, and Levi P. Morton, of New York, for Vice-President. The Democrats renominated President Cleveland, and placed Allen G. Thurman, of Ohio, second on the ticket. Harrison and Morton received 233 electoral votes; Cleveland and Thurman received 168. Both Senate and House were strongly Republican. The administration of President Harrison was signalized by the enactment of important legislation, and by a strong foreign policy. Thomas B. Reed was Speaker of the House of Representatives in the 51st Congress, with a narrow Republican majority. The Democratic minority essayed at the beginning of the Congress to prevent all Republican legislation by appealing to the technicalities of antiquated rules. Speaker Reed in

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the face of vehement opposition secured the adoption of new rules, under which it became possible for the majority to do business. The Reed rules, although angrily assailed by the Democratic minority, were adopted by the Democratic Party when it next came into control of the House, and they have prevailed ever since. Having obtained the power to legislate, the Republican Party in the House proceeded to enact a tariff bill in obedience to the command of the electorate. The McKinley act was signed 1 Oct. 1890. A law was passed, known as the Sherman anti-trust law, providing penalties for creating combinations in restraint of interstate trade. The House of Representatives passed a bill looking to the more efficient control of Federal elections. This measure aroused great Democratic opposition. It failed to pass the Senate. During Harrison's administration a revolution in Hawaii resulted in the deposition of Liliuokalani, the native queen. A republic was set up, and a commission was sent to Washington seeking annexation to the United States. President Harrison made a treaty of annexation which the Senate failed to ratify in the few weeks remaining of the administration. The treaty was withdrawn by President Cleveland, but Hawaii was finally annexed shortly after the return of the Republican Party to power in 1897.

The congressional election of 1890 was fought on the issue created by the McKinley bill. That act went into operation only a month before election, and there was no opportunity to observe its practical workings. Its intent and effect were misrepresented, and the Democrats carried the House of Representatives by an unprecedented majority. In the 52d Congress, the House contained 235 Democrats and only 88 Republicans. The election of 1892 resulted in turning all branches of the government over to the Democratic Party. Cleveland and Stevenson were elected President and Vice-President, receiving 277 electoral votes; Harrison and Reid, nominated at Minneapolis, 7-10 June 1892, received 145 votes. Both House and Senate were strongly Democratic in the 53d Congress. The administration had come in on a platform which denounced protection as a fraud, and declared it to be a fundamental principle of the Democratic Party that the Federal government has no constitutional power to impose and collect tariff duties except for the purposes of revenue only. The election of a Democratic President on this platform created distrust in business circles and caused a paralysis of industry which resulted in a financial panic, hitherto unequalled, during the spring of 1893. President Cleveland, assuming that the financial depression was due to the operation of the Sherman act, providing for the purchase of silver bullion, called a special session of Congress to repeal that act. The Republicans in the House and Senate combined with a small number of Democrats to carry out the President's recommendation, and finally after weeks of heated discussion the law was repealed, but the financial situation was not relieved. The money stringency continued with the dread of tariff legislation hanging over the country. A tariff bill was enacted after months of debate which did not go to the lengths recommended by the President, and which he accordingly denounced as an act of perfidy and dishonor, although he refrained from vetoing it.

The fight over the repeal of the Sherman act and over the Wilson-Gorman tariff act disrupted the Democratic party. The unpopularity of the administration's foreign policy completed the disintegration, and at the congressional elections held in 1894, the Republican Party again came into control of both branches of Congress.

In 1896 the Republicans at Saint Louis, 16-18 June, nominated William McKinley for President, and Garret A. Hobart, of New Jersey, for Vice-President, on a platform declaring for a protective tariff and for the maintenance of the gold standard. The Democratic convention at Chicago was carried away by the cry for free silver coinage at the ratio of 16 to 1. William J. Bryan, of Nebraska, and Arthur S. Sewell, of Maine, were nominated for President and Vice-President, respectively. The campaign was fought chiefly on the financial planks of the two platforms. McKinley and Hobart were elected by a decisive majority, both in the electoral college and of the popular vote. They received 271 electoral votes. Bryan and Sewell received 176 votes. Both Senate and House were strongly Republican, in the 55th Congress. Thomas B. Reed was Speaker of the House, and Nelson Dingley, of Maine, was chairman of the Committee on Ways and Means. A special session of Congress was called to carry into effect the pledges of the party with regard to the tariff. The Dingley tariff act became law 24 July 1897. It marked the beginning of a period of prosperity unequalled in the previous history of the United States.

The disturbed conditions in Cuba growing out of the uprising against Spanish misgovernment were rapidly reaching a point where intervention by the United States would have become inevitable when the destruction of the battleship *Maine* by a Spanish mine in Havana harbor on 15 Feb. 1898 roused the resentment of the people and precipitated the war with Spain. The war began on 21 April 1898. The American forces gained two great victories by sea, one in Manila Bay, on 1 May 1898; the other off Santiago harbor on 3 July. After a brief and effective campaign by land, Spain sued for peace. The treaty of peace was signed at Paris on 10 Dec. 1898. It provided for the acquisition by the United States of the island of Porto Rico in the West Indies and of the Philippine Archipelago and the island of Guam in the Pacific. It placed the island of Cuba temporarily under the guardianship of the United States. The McKinley administration undertook the government of the newly acquired territory with all the serious problems involved. It quickly set up a stable American government in Porto Rico. It brought order in Cuba under a military administration, prepared the people of the island for self-government, and on 20 May 1901 withdrew the American military forces, permitting the Cuban people to set up an independent republic of their own. In the Philippines, after four years of armed opposition by guerrilla tribes in Luzon, a civil government was finally established and the people of the island were given a degree of civil freedom such as they had not known in 400 years. Early in the McKinley administration resolutions were enacted providing for the annexation of Hawaii on terms similar to those contemplated by President Harrison in the treaty of annexa-

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tion, which President Cleveland withdrew. President McKinley was renominated at Philadelphia on 19-21 June 1900. Theodore Roosevelt was nominated by acclamation for Vice-President. William J. Bryan was again nominated for President at Kansas City on 4 July, with Adlai E. Stevenson, of Illinois, for Vice-President. The Democrats re-affirmed the platform of 1896 with its declaration of free-silver. But they declared the paramount issue to be the question of imperialism. The Republican candidates received 292 votes in the electoral college; the Democratic candidates 155 votes. The Republicans retained control of both Senate and House. On 6 Sept. 1901, President McKinley was shot at Buffalo by the anarchist Czolgosz. On 14 September he died. Vice-President Roosevelt succeeded to the Presidency. He pledged himself to carry out the McKinley policies under which the country had experienced unparalleled prosperity and he retained all members of President McKinley's cabinet. During President Roosevelt's administration all laws were strictly enforced. The army was reorganized and a strong foreign policy maintained so successfully that, in 1904, the popular demand for his re-nomination was imperative. He was elected, therefore, by a vote of 336 to 140 cast for Judge Parker. Charles W. Fairbanks, of Indiana, was the candidate for the vice-presidency.

The preamble of the platform of the Republican Party, which was adopted at Chicago 22 June 1904, contained the following review of the purposes for which the party had stood for half a century. It had been dedicated, it stated, among other purposes in the past, to "arresting the extension of human slavery," and using this as a text, the platform developed in detail the proposals for the coming administration for which Mr. Roosevelt had been nominated as President. It stated that, "after four years of Democratic rule, in evil plight, oppressed with misfortune, and doubtful of the future, public credit had been lowered, the revenues were declining, the debt was growing, the Administration's attitude towards Spain was feeble and mortifying, the standard of values was threatened and uncertain, labor was unemployed, business was sunk in the depression which had succeeded the panic of 1893, hope was faint, and confidence was gone." Then was pointed out the proud allegation that the Republican Party had "replaced a Democratic tariff law, based on free-trade principles and garnished with sectional protection, by a consistent protective tariff; and industry, free from suppression and stimulated by the encouragement of wise laws," had expanded to a degree never before known, had conquered new markets and had created a volume of exports which surpassed imagination; that under the Dingley Tariff labor had been fully employed, wages had risen and all industries had revived and prospered.

The first declaration of principles for the future which the platform contained was in favor of the gold standard, and explaining why the party favored this principle. The settlement of affairs in Cuba, Porto Rico, the Philippines, and all the relations of American industrial life had depended upon the gold standard. Our possession of the Philippines was defended in a strong paragraph. The Pana-

ma Canal undertaking would be carried on as it had been begun by strong Republican endorsement and lines of effort. Likewise, anti-trust laws, enacted by the Republican Party, "which the Democratic Party failed to enforce," would be carried forward, and new laws would be enacted insuring "reasonable publicity as to the operations of great corporations and providing additional remedies for the prevention of discrimination in freight rates." The protective tariff was restated and upheld. The further extension of commercial reciprocity, already secured by the Republican Party, would be effected, "without injury to American agriculture, American labor, or any American industry." The merchant marine would be upbuilt by the furtherance of the work of the Merchant Marine Commission. A strong navy would be built up. Chinese labor would be excluded. Civil service laws would be enforced. International arbitration would be favored, as it had been by the administrations of President McKinley and President Roosevelt. Congressional action would be taken to determine "whether by special discriminations the elective franchise in any State has been unconstitutionally limited" (this referring to negro disenfranchisement), the demand being that "representation in Congress and in the Electoral College shall be proportionately reduced as directed by the Constitution of the United States." Combinations of capital and labor should not be permitted to "infringe upon the rights and interests of the people," although "when lawfully formed 'or lawful purpose,' such combinations are 'alike entitled to the protection of the laws, but both are subject to the laws, and neither can be permitted to break them.'"

The Republican platform adopted at Chicago 18 June 1908, upon which Secretary of War, William Howard Taft, was elected over Mr. Bryan (Dem.) and others, was longer, though no stronger, than that of 1904.

Republicanism under Mr. Roosevelt was reviewed. Equality of opportunity was pointed out as a leading principle and attainment of American life under Republican rule. The attainments of the nation in both its internal and external affairs were described. The revival of business and the wise and progressive legislation recently adopted were pointed out. The party declared unequivocally for a revision of the tariff by special session of Congress immediately following the inauguration of the next president, for which purpose a thorough investigation of schedules and trade conditions was recommended. The currency laws were justified. The establishment of a postal savings bank system was favored. "Greater supervision and control over the trusts" was urged by "greater publicity in the management of that class of corporations engaged in interstate commerce having power and opportunity to effect monopolies." The party gave its approval to "the enactment of the Railroad Rate Law and the vigorous enforcement by the present administration of the statutes against rebates and discriminations"; especially favoring such national legislation and supervision as would "prevent the future overissue of stocks and bonds by interstate carriers." Laws for the protection of railroad and government employes were recommended; likewise the policy of protection of

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American labor in general. The authority and integrity of the courts and court procedure were upheld. The welfare of the American farmers was duly considered. Justice to the negro was sought by clearly defined recommendations. The improvement of natural resources and waterways; the strength and efficiency of the army and navy; the protection of American citizens abroad; the extension of foreign commerce; arbitration and the Hague treaties; the revival of the merchant marine; the increase in the pension list; maintenance of the civil service; the public health; the establishment of a bureau of mines and mining; citizenship in Porto Rico; home rule in the Philippines; the completion of the Panama Canal; the admission of the Territories of New Mexico and Arizona as separate States—all were given strong recommendations in this platform.

See also DEMOCRATIC PARTY, where the result of the election itself is analyzed. The proper course of legislation in 1909-10 was unusually plain, on account of the Chicago platform of 1908, in the drawing of which Mr. Taft himself had had a prominent part. As President he at once upheld the fact that this platform was part of a tacit contract with the people, and that its pledges were to be fulfilled. Therefore, in both his speeches and messages, he called the attention of the legislators repeatedly to its provisions.

Since the Republican Party came into power for the first time in 1861 it has been continuously in possession of the Presidency except during the periods between 1884 and 1888 and between 1892 and 1896. It has been in control of the House of Representatives except during the 44th, 45th, 46th, 48th, 49th, 50th, 52d, and 53d Congresses. It has been in control of the Senate almost continuously, the only lapse being between 1879 and 1881 and between 1893 and 1895. It has thus in effect had control of the government for 45 years and there is not a single important piece of legislation on the statute books to-day which was not placed there by the Republican Party. The only important legislation enacted by the Democratic Party in 45 years has been the Wilson-Gorman tariff act which a Democratic President allowed to become a law without his signature and which was repealed by the Congress immediately succeeding that in which it was enacted. The Republican Party has brought two wars to a successful conclusion,—the Civil War and the war with Spain. It has abolished slavery in the United States. It has placed on the statute books four protective tariff acts, the Morrill tariff of 1861, the tariff of 1883, the McKinley tariff of 1890, and the Dingley tariff of 1897. It enacted in 1862 the Homestead Law, under which the vast unoccupied territory of the West was thrown open to settlement by American citizens. It is responsible for the 13th, 14th and 15th amendments to the Constitution and for the acts of reconstruction immediately following the Civil War. It is responsible for the resumption of specie payments in 1878, and for the creation of the Civil Service Commission divorcing the subordinate offices in the government service from party politics. It is responsible for the reform of the rules of the House of Representatives under Speaker Reed enabling the majority to transact business. It is re-

sponsible for the upbuilding of the American navy until it ranks third in size among the navies of the world, and second to none in efficiency. It has reorganized the army and put it in a state of constant readiness. It has added to the national domain Alaska, Porto Rico, Guam, Hawaii, and the Philippines. It has set up an independent republic in Cuba. Since it came into power the country has increased in population from 31,443,321 in 1860 to 76,303,387 in 1900. The wealth has increased from \$16,159,616,000 in 1860 to \$94,300,000,000 in 1900.

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L. A. COOLIDGE.

Republics, The History of. The word Republic is derived from the Latin *res*, a thing, and *publicus*, belonging to the people. The word is frequently applied to any group of individuals having a common interest in their pursuits, as the republic of letters. Its general usage, however, is as a political designation for a state or country in which the supreme power of governing is vested in rulers elected periodically by those of its citizens who have acquired the right to vote. In the narrowest sense, a republic is a democracy where political power rests in all the people and is wholly in their unrestricted control. It is the antithesis of a monarchy, where the power rests in one individual or family and is self-perpetuating through dynastic succession. Between these two extremes of monarchic and democratic government are other forms, of oligarchic or aristocratic character, where the right of participation in the direction of public affairs is in the hands of classes or of a restricted portion of the community. Strictly speaking, these are not republics, but in history nearly all authorities agree in so regarding and placing them. Republics may be divided into two distinct types, the centralized and the non-centralized. A centralized republic is one in which all power is deputed to and is exercised by the general government entirely independent of local authority in any of the sub-divisions of the country. France and some of the South American republics are examples of the centralized republic. When the power of the general government is derived, to a greater or less extent,

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from the local constituent bodies or states which also have independent rights and powers over which the general government has no constitutional control, we have the non-centralized republic. The Greek republics, the free cities of Germany and the United States of America are examples of the non-centralized republic.

The Earliest Republics.—In pre-historic times when men first began to feel the necessity for communal control of their affairs and interrelations, government took somewhat the form that has persisted in modern times in the monarchy. At the beginning this was patriarchal, as history shows us at later date among the Hebrews, the Pelasgians, and other early races. The head of the family was recognized as supreme in authority, first over his immediate family and then over its branches. As the associated families grew in number and size, and expanded into tribes, the strongest family or group of families asserted its pre-eminence, by force or peacefully, by common consent, and became the ruling power; hence the king and the dynasty. It was a reversion from this condition that led to the earliest republics of which history has anything to tell. Among the Israelites, the patriarchal or family government continued until the time of the Egyptian serfdom. When, under Moses, the people escaped from Egypt and became again free and independent, the Israelitish Commonwealth or Republic was established; it lasted nearly four centuries, from 1491 B. C. to 1095 B. C. Under Moses and Joshua the government was of the consolidated and centralized type. All the people, young and old, rich and poor, male and female, had a voice in public affairs and the privilege of political preferment. Here we have the earliest record of choosing rulers by elective franchise. Only the priesthood was a privileged class. Laws were beneficent and wise. A general system of education was established. The military spirit was fostered so that the nation became a strong power. Usury was illegal and interest was regarded with disfavor. An agrarian law assigned to each family a small acreage of land and this was made inalienable; it could not be held under mortgage or sale. Of this early stage of the republic it has been said that "the descendants of Abraham had reached a higher state of virtue and happiness than any other nation of that period." Upon the death of Joshua the seeds of disintegration were sown. The different states seceded, forming independent confederacies, although generally all were united for common defense. Dissensions arose, patriotism weakened, officials became dishonest and finally the people, whose will was still the highest law of the land, demanded of Samuel a king. Saul was anointed king in 1095 B. C. and that was the end of the Israelitish republic.

Greece.—In the Heroic Age, Greece was divided into several states or tribes, each ruled by a chief or king. It was about the time of the first Olympiad—776 B. C.—772 B. C., that the people began to aspire to political independence, and they gradually deposed the kings, setting up chosen rulers in place thereof. At first the new governments were oligarchal, but in the course of time, all of them, except that of Sparta, became democratic. The states were only loosely bound to each other and national unity was

altogether lacking. Athens became foremost in the time of Thucydides and exercised a sort of sovereignty over the entire country. But after a while Sparta imposed her oligarchic system upon the other states and then again Thebes had the ascendancy. Greek civilization, Greek laws, Greek art, Greek literature, Greek patriotism, became forces that have never ceased to dominate the world. But the passion for wealth and display, local political strife and particularly jealousy between the different states and cities led to dissension and disunion. Greece came under the influence of the Persian monarchs, then was ruled by the Macedonian kings, Philip and Alexander, and finally, when in 146 B. C., the Roman legions conquered Macedonia, the last Grecian league, the Achæan, and then Athens, were completely vanquished. Successively under the domination of the Roman Empire of the East, the Byzantine Empire and Turkey, Greece, finally reunited, became an independent kingdom, under a constitutional monarchy in 1832.

Carthage.—Carthage had its beginnings before history had its records. Five centuries before Christ, it flourished under rulers who were not hereditary, but who were elected by the people. The Commonwealth of Carthage was a centralized republic, unlike that of Greece and similar to that of Rome. In the Great Council of the State and in the Council of the Elders there was something of aristocracy, but on the whole the people were in control. There was a liberal administration in the interest of all citizens alike, courts of justice, banking institutions, public libraries and schools of literature and art. Carthage acquired great wealth and a high degree of civilization. Her territory was wide, extended and rich, and the city, Carthage, capital of the country, was the most superb of that day, being to the republic what Paris is to France. Carthaginians conquered the then known world, penetrated to the interior of Africa and sailed around the Cape of Good Hope, and through the British Channel. The prosperity of the Commonwealth begat its downfall. Political feuds developed and its citizens became divided into factions. Rome, grown in power, saw the opportunity for revenge for earlier defeats and humiliations. Her legions swept over the country. Carthage, the splendid city, was blotted from the face of the earth, never to reappear, and with her went every vestige of the republic of which she was the metropolis.

Rome.—Like Israel and Greece Rome had its political beginning in peoples who were organized in families, clans and tribes. In the early Roman state a king was the ruler, partly an hereditary chief and partly an elected magistrate. Naturally the kingly office grew in importance and power until in the time of the Tarquins it was well-nigh supreme. Still even during this regal period the people retained much power. The inhabitants were divided into two classes, patricians and clients, and the franchise and right of office-holding were possessed only by the former. A similar condition existed under the Etruscan kings, who ruled from the 7th century before Christ. With the deposition of Tarquin, the Proud, at the close of the 6th century before Christ, the Roman Republic began and lasted until 27 B. C., nearly five

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centuries. Of the early years of the republic little is positively known. Romance and tradition make up a large part of the story. In order to curb the growing power of the executive office, administrative authority was vested in two elected consuls, with limited tenure of office, but as had always been, the franchise still remained in the patrician class to the exclusion of the plebeians. No sooner was the republic fully established than a struggle for power began between the two classes and lasted for several centuries. The patricians endeavored to establish an exclusive aristocratic government on the ruins of the monarchy, and the plebeians demanded a large participation in common civic privileges. Slowly but surely the plebeians gained. Gradually the social and political barriers between the classes were broken down and by the 3d century before Christ, practically all distinctions in regard to the franchise and office holding had disappeared. In 200 years the Romans emancipated themselves, first from kingly and then from oligarchal domination. During these and the ensuing centuries, constitutional changes were frequent, but until toward the end, generally to the enlargement of the powers of the people. Under this republican government, Rome arose to a civic distinction unparalleled at that time. The story of the city and state fills the most brilliant pages of ancient history. Her law is to-day largely the basis of law throughout the civilized world. She made herself mistress of the peninsula of Italy and then conquered the world. Her power became colossal and then her conquests proved her undoing. War made her a military nation and agriculture was neglected. The spoils of victory brought to her enormous wealth and created great fortunes for her soldiers. Inordinate extravagances followed and resultantly the condition of the poorer classes became more and more distressing. Reverence for law disappeared, many attempts were made by the aristocracy to control the power of the masses and the state became an arena on which men were merely contending for power, wealth and influence. The civil war in which Marius and Sulla were the leaders was the final struggle between the aristocratic and democratic elements. Constitutional government had been long forgotten and in the general distress all classes of citizens felt that a change of government with a strong man at the head was the only thing that could save the state. So Sulla was proclaimed dictator in 81 B. C. In form the republic endured for 50 years more under the consulships of Pompey, Cæsar, Crassus and Cicero, but it was little more than form. The dictatorship of Cæsar in 48 B. C. was another step toward the end, and Rome was ready for the empire when Octavius Augustus came to the head of the state and was proclaimed imperator in 33 B. C. Republican institutions more and more faded into the background during the life of Augustus and in all but name he was an absolute monarch. When Tiberius succeeded to the throne, Rome was an empire in reality.

Mediæval Republics.—Coming to mediæval times, there were the Lombard communes, the independent cities of Italy, the free cities of Germany and Iceland, all of which had republican forms of government. Lombardy, in the north of Italy, was a separate kingdom, part

of the Carolingian empire, or annexed to the German Empire until near the close of the 10th century. Then arose a number of independent duchies, as Mantua, Susa, Piedmont and others and several independent cities that in the 11th century became republics. Among these were: Florence, Milan, Padua, Piacenza, Treviso, Modena, Cremona, Vicenza, Bologna, and others. In them municipal organization grew up independent of church or empire that had heretofore dominated. Consuls were elected by the citizens and arts, crafts and guilds had part in the control of affairs. Between these cities there was no firm federal compact but in times of danger they formed powerful leagues for mutual defense. But although they grew in wealth, power and influence, their governments were never stable. They quarreled with each other and were torn by internal dissensions, constantly shifting between the power of the people and the power of the few. The history of Florence, which remained longest the champion of constitutional liberty, is a story of centuries of contention between the forces of democracy and oligarchy. One by one these cities finally fell before the assaults of foes, were incorporated into kingdoms, duchies or principalities, becoming, in some instances, possessions of Austria and finally were incorporated into the kingdom of Italy. In the 10th century Genoa established a free constitution. During the next two centuries the republic increased in wealth and power. A world-wide commerce was established, and many of the large cities of Southern Europe and Asia came under her control, as Marseilles, Nice, Venice, and Constantinople. At the outset, the constitution of the state leaned toward an aristocracy. A bitter antagonism between conservatism and democracy developed, changes of government became frequent, and in 1339 the citizens elected a doge for life. Three centuries later Genoa yielded to Austria and then to France, by the treaty of Vienna became a tributary city of the Sardinian monarchy and ultimately a part of the Italian kingdom. Venice had an independent government in the middle of the 6th century, her rulers being called military tribunes. From 697 to 755 the elected chief magistrate was the doge, whose authority was well-nigh imperial. Universal suffrage existed, but during the season of the republic's greatest prosperity, wealth and aristocracy for the most part administered public affairs. In time the democracy demanded more rights and privileges and in the 11th and 12th centuries the strife between the aristocracy and the commonalty was determined and bitter. In 1172 the government became essentially a patrician oligarchy with constantly increasing power, and in 1298 popular elections were abolished by the Great Council. Further encroachments upon the civic rights of the people, expensive wars with sister republics and selfish legislation of the oligarchy undermined patriotism, and for four centuries the classes fought with each other. In 1674 the oligarchy yielded to the commonalty and for another century the republic continued in varying fortune until Napoleon, in 1797, placed it under the domination of Austria. Amalfi, on the west coast of Southern Italy, was an independent city of 50,000 inhabitants in the 9th century and the

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capital of a flourishing republic. Toward the close of the 11th century Amalfi was subjugated by the Normans.

Later Struggles.—The larger towns and communities of northwestern Europe gradually freed themselves from the exactions of feudal lords and became independent. From the beginning of the 12th century they established a large commercial intercourse between themselves and with the world. To protect themselves against marauders and to develop their commercial interests, they formed the Hanseatic League in the 13th century. Hamburg, Lubeck, Bremen, Frankfort and Cologne were the principal cities in this league, but city after city joined the union until it embraced 85, and in power matched the strongest governments of Europe. These cities were sovereign states and, while part of the German confederation or empire, they exercised full authority in their local affairs. In the Hanse confederacy they held the Baltic in dominion and controlled the foreign commerce of Northern Europe. The league lasted until 1630 although previous to that date it had been shorn of its powers. Most of the cities had been absorbed into the German kingdoms or principalities and at last only Hamburg, Lubeck, Bremen and Frankfort remained independent. In 1813 these four became free members of the German confederacy, but in 1866 Frankfort fell to Prussia. Hamburg, Lubeck and Bremen still retain their freedom in local affairs, being governed by chambers of representatives elected by popular vote. Iceland was settled by exiles from the tyranny of the princes of Norway, Denmark and Scotland, in the 10th century and a republican form of government was established in 928. At the head was placed a supreme magistrate, elected by the people and sharing authority with a general assembly. This form of government lasted for nearly 400 years and Iceland attained to civilization and a measure of prosperity. But internal dissensions sprang up and civil wars devastated the island. In 1621 the national council, by common consent of the people, invited Haco, King of Norway, to become Iceland's ruler and in 1380, again by common consent and peacefully, the island was transferred to Denmark. During the 10th, 11th, 12th, and 13th centuries, the whole of Belgium and Bavaria was split up into small dominions. In 1383 the house of Burgundy obtained control of this territory, which afterward became the 17 provinces of the Netherlands. Following the Burgundian rule came the long struggle with Spain, which ended in 1648 with the peace of Westphalia, by which the independence of the Republic of the United Provinces was acknowledged by the great powers of Europe. The provinces had formally united, with William of Orange as stadtholder, in 1580. The republic continued through many vicissitudes, for two centuries, the people enjoying political freedom and the nation acquiring a high degree of power and prosperity. European politics could not withhold its hand from the Netherlands, and the Dutch provinces were in constant turmoil within and engaged in war without. In 1747, through all these influences, William IV. was made captain and admiral-general of the

whole union and stadtholder of the seven provinces: a little later these offices were made hereditary in both the male and female lines. At the time of the French Revolution, the stadtholder was driven out by the French and the old republican forms of government re-established, but in 1814 the people recalled the Prince of Orange from his exile in England and established the monarchy, under William I., King of the Netherlands.

France.—The first French republic had an inglorious career of 12 years. It began with the overthrow of the monarchy in 1792, and ended with the crowning of Napoleon as Emperor of France, in 1804. The 12 years of this republic were 12 years of terror. A state of anarchy existed, not a state of government. It was a despotism of a democratic mob united with the despotism of a democratic dictatorship. When the passion of the hour had burned itself out and Robespierre, Marat, Danton, and other leaders had fallen, France turned again to a monarchy for self-preservation. For the second time the people, in 1848, overthrew the monarchy and re-established a republic. The king, Louis Phillippe, abdicated and fled to England and a new constitution was adopted, providing for a president, a council of state, and an assembly elected by popular vote. Louis Bonaparte was elected the first president, and in 1852, by an almost unanimous vote, he was accepted as hereditary emperor under the name of Napoleon III. The second empire lasted for 18 years and was succeeded by the third republic in 1870, which was in stable and unthreatened existence in 1905. The defeat of France by Germany in 1870 led to the overthrow of Napoleon III., and the Napoleonic dynasty. For more than a third of a century now France, the republic, has steadily grown in wealth and power, and is reckoned as one of the strongest nations of Europe. Its government is a pure democracy and authority is vested in a president elected for seven years, by the Congress and a Senate and Chamber of Deputies elected by the people, the latter by popular vote, and the former by an electoral body.

Switzerland.—Besides France there are now three republics in Europe. The most important is that of Switzerland. The Swiss republic dates from 1291, when the men of Uri, Schwyz and Unterwalden entered into a defensive league. Other cantons were added to the league until, in 1798, under the influence of France, the Helvetic Republic was formed with a regular constitution. In 1815 the perpetual neutrality of Switzerland and the inviolability of her territory was guaranteed by the powers of Europe. The republic is non-centralized, each canton having independent local powers. The federal government consists of a state council of members elected by the separate cantons and a national council elected by the people as a whole. The president and the vice-president are elected for terms of one year by the federal assembly. Universal suffrage prevails and the compulsory referendum and popular initiative are features of legislative procedure.

Andorra.—Andorra, in a valley of the eastern Pyrennees, between France and Spain, is under the joint suzerainty of these two countries. It was declared a free state by Charlemagne and

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has always retained its independence. It is governed by a council of 24, elected by the people, and the chief executive is a member of the council, elected for life by his associates. It has a population of less than 10,000.

San Marino.—San Marino, in Italy, is the oldest existing republic in the world. It embraces five villages with a population of about 8,000. The general government is intrusted to a council of 60, the chief officer being termed Captain-Regent.

The United States.—On the western hemisphere, with the exception of the Dominion of Canada and the smaller dependencies of Great Britain, France and Denmark, every country is under a republican form of government. The United States of America is the oldest of these republics, the most extensive in territory and the largest in population. It stands among the world's greatest powers and in its influence it dominates the western world. As a nation, the United States originated in the colonies of Great Britain that existed in the eastern, middle and southern sections of the New World in the 18th century. The inhabitants of these colonies were mostly of English origin but they rebelled against the rule of the mother country and united in establishing themselves as a free nation, under the Declaration of Independence in 1776. In form of government, the country is a non-centralized republic, and its constitution and form of government have been the pattern upon which all republics have been modelled since its beginning. The president, who serves for a term of four years, is chosen by an electoral college, the members of which are elected by popular vote in the several states and represent the state-at-large and its congressional districts. The Senate consists of two members from each state, elected by the state legislature. The House of Representatives consists of members elected by popular vote in the separate congressional districts in the several states. There is a federal judiciary and in foreign relations, interstate commerce, army and navy affairs, navigation and postal service, the federal government is supreme. Each state is wholly independent in the control of its own affairs, having a form of government like the federal, a governor, upper and lower houses of legislation and state judiciary. The nation has had a prosperous existence. It had been engaged in wars with England, France, Mexico and Spain, and passed through a civil war, 1861–5, the greatest that the world has ever known. It has expanded until now it covers the northern part of the hemisphere from the Atlantic to the Pacific and from Canada on the north to Mexico on the south. As a result of the Spanish-American war, the republic entered upon a colonial policy and extended its operations across the Pacific. It acquired the Philippine Islands by the treaty of 1898 and also the islands of Porto Rico and Guam, and all three have been held as colonial dependencies. Hawaii, whose white citizens had revolted from native monarchical rule and set up an independent republic, was annexed to the United States in 1898 as a territory. For centuries the island of Cuba was under the misrule of Spain. Insurrection followed insurrection against the Spanish power, but Cuba was held fast as a

Spanish colony until the Spanish-American war, of which it was the cause. In the peace treaty between the United States and Spain, Cuba was relinquished. It was temporarily held by the United States pending the establishment of a stable home government, but in 1901 this was accomplished and in the following year, with Tomas Estrada Palma at its head, free Cuba took its place as the latest republic in the world. Universal suffrage with educational qualifications prevails, and the form of federal government and methods of election follow closely those of the United States of America.

South America.—The South American republics are ten in number, Argentine, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. Early in the 16th century Spain invaded and subjugated Peru and achieved a conquest of almost the entire South American continent. For three centuries she was able to master and hold not only that portion of the hemisphere, but also territories of Mexico and Central America and a great part of what is now the western and southwestern section of the United States. In South America she divided power only with Portugal. In the first quarter of the 19th century most of the South American states achieved their independence and established themselves under republican forms of government. The agitation for emancipation broke out almost simultaneously in different parts of the continent but was not always quickly or easily successful. In 1810 the Chilians revolted against the king of Spain and a junta which met at Santiago elected the Marquis de la Platte, a native Chilean, president of the republic, but it was not until 1818 that independence was formally proclaimed. A constitution was voted in 1833. The Argentine provinces freed themselves from the Spanish yoke in 1810, but were immediately embroiled in disputes and contentions among themselves. The history of the republic is a record of anarchy, civil contentions and warfare with European nations and sister republics. The existing constitution was adopted in 1853. Paraguay gained its independence in 1811, and after a short period of government by two councils, the supreme power was seized in 1815 by Dr. Jose Gaspar Rodriguez Francia, who exercised autocratic sway as dictator until his death in 1840. A state of anarchy followed and lasted two years, after which a National Congress put two consuls at the head of affairs. The dictatorship of President Lopez followed, and in 1870 a new constitution was voted, making the country a full-fledged republic. Bolivar, the liberator, began his work for freeing South America from the Spanish yoke in 1809. After alternate defeat and success, he finally triumphed, and in 1819 united New Granada and Venezuela as a republic under the name of Colombia. In 1832 the republic split up into Venezuela, Ecuador and New Granada, and after several changes in constitution and in state membership, the country became, in 1886, the Republic of Colombia. In 1820 San Martin, at the head of an invading army from the republic of Chile, entered Peru, drove out the Spanish authorities and proclaimed himself Protector. Two years

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later Simon Bolivar, at the request of San Martin, entered the country and was appointed Dictator. Under Bolivar, Peru achieved her full freedom. A succession of civil wars and constitutional changes followed during a period of over 30 years. A constitution, in the modern spirit, was proclaimed in 1856 and under it the republic has continued since. In 1825 the republic of Bolivar was instituted from the southern province of Peru by Simon Bolivar and named after its founder. The constitution that was then formed underwent important modifications in 1828, 1831, 1863 and 1880. For nearly two centuries the territory of Uruguay was the subject of almost constant contention between Brazil and Buenos Ayres. In 1828, by the mediation of England, the northern part of the territory was ceded to Brazil and the southern part was erected into the republic of Uruguay, having declared its independence three years before. The constitution was established in 1830. The republic of Ecuador was constituted in 1830, as the outcome of a civil war, which separated the members of the original republic of Colombia formed by Simon Bolivar upon the ruins of the Spanish kingdom of New Granada. Its constitution was voted in 1844 and modified in 1887. Venezuela also had its origin in 1830 in the break up of the Bolivar republic of Colombia. The Spanish flag was cut down in this province in 1811 and the struggle against Spain was carried on until 1823, when the Spanish troops were completely expelled. The charter of fundamental laws was put in force in 1830 and has been several times modified. Of all the South American countries, Brazil remained longest under a monarchy. It was an apanage of Portugal until 1815. The royal family of Portugal fled to Brazil in 1807 and establishing the throne there, the colony was declared a kingdom in 1815. When the royal family returned to Portugal in 1821, Brazil declared itself independent with Dom Pedro, son of Don Joao VI., of Portugal, as Emperor. The throne came to Dom Pedro II. in 1831, and he ruled until 1889, when by a revolution he was deposed and with his family exiled to Europe. Brazil was declared a republic under the name of the United States of Brazil. In origin, in career, and in form of constitutional government, the South American republics show striking similarity. The cry for liberty expressed in the French Revolution and more especially the successful establishment of the republic of the United States of America inspired the patriots of the southern part of the hemisphere to the struggle for freedom. In establishing constitutional government, they took pattern from the United States of America. Universal suffrage with age and educational qualifications prevails. The central government in each republic consists of a president and two legislative branches, a senate and a house of representatives, or house of deputies. Methods of electing the president and members of the senate and the house vary somewhat, but directly or indirectly the principle of the rule of the people is adhered to. The states or provinces that constitute each republic generally have full freedom in their local affairs, although in several republics federal officers have more or less control. Theoretically the South Amer-

ican governments are non-centralized republics. Practically the federal government is a strongly centralized power. The population may be broadly divided, as far as government is concerned, into two classes, the ignorant and indigent, and the ambitious and turbulent. Consequently the history of these governments has been almost uniformly a story of intrigue, revolution, sanguinary civil war and domestic upheaval. Presidents have held themselves in power by bayonets, usurpers have arisen supported by the army, and dictators have ruled under the name of presidents and nominally so elected. Nearly all of the republics are laden heavily with debts and are in frequent controversy with their foreign creditors. Brazil and Chile are the most stable and most promising of these republics.

Central America.—The Central American republics are Costa Rica, Guatemala, Honduras, Nicaragua, San Salvador and Panama. Central America, after freeing itself from Spain in 1821, until which time it was known as the kingdom of Guatemala, was attached to the kingdom of Mexico. In 1823, Guatemala, Honduras, Nicaragua and San Salvador formed an independent federal union, under the name of the United States of Central America. Subsequently the states dissolved this alliance and became independent, Guatemala in 1847, Honduras in 1839, Nicaragua in 1858, Costa Rica in 1829 and San Salvador in 1853. These republics are republics only in name. Each has a constitutional government and popular suffrage. In form the federal authority consists of a president, and two legislative houses. In fact, the government is always in the hands of a few strong men who exercise autocratic power. Revolutions are frequent, the factions resort to arms whenever desire or opportunity impels, and there is no security of life or property. Panama, which may, perhaps, be considered as belonging almost as much to South America as to Central America, was originally part of the republic of Colombia. When the latter country hesitated in coming to an understanding with the United States in regard to the construction of the Panama canal in 1903, the department of Panama seized the opportunity to secede from her associate. There was a bloodless revolution of a few days. Panama declared itself an independent republic and was recognized at once by the United States. Now that the work upon the Panama canal through its territory has been begun, it is practically under the protection of the United States.

West Indies.—In the West Indies is an island on which there are two nominal republics, known as the black republics. Hayti, governed first by Spain and then by France, became free in 1793. First the free colored population gained the franchise in 1791 and then all the negroes in 1793 under the leadership of Touissant l'Ouverture, acquired freedom. In the last century the island had varying fortunes, sometimes under English, French or Spanish domination, twice an empire and several times republican. San Domingo republic, on the eastern end of the island, was established in 1844. The government is in the hands of an elected president and two legislative houses, but control of affairs is constantly being changed

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by revolutions and the setting up of dictatorships. The republic of Hayti, on the western end of the island, has a similar history, under a like form of government proclaimed in 1867. In both republics the government is in the hands of negroes and mulattoes who constitute almost the entire population.

Mexico.—From the time that Cortes conquered Mexico, 1518-20, that country remained in the hands of Spain for three full centuries. Finally in 1810 rebellion broke out and Iturbide, the liberator, was proclaimed emperor. Upon the death of Iturbide, the army organized a republic and Mexico was entirely freed. For nearly half a century there was only the merest semblance of government of any kind. The history of the period is a record of anarchy, intrigue, revolution, military leaderships and dictatorships. In 1857 a constitution was formed, but the existing condition of internal disorder did not terminate. The French made war against Mexico and Maximilian was created emperor by a provisional government in 1862. Upon the execution of Maximilian in 1867 the republic was more firmly established but it was not until as late as 1878 that under Porfirio Diaz the country became settled. Mexico is a federative republic, divided into states, each of which manages its own local affairs, while the whole are bound together by fundamental and constitutional laws. The powers of government are exercised by a president, senate, house of representatives and judiciary.

Africa.—On the western coast of Africa is the republic of Liberia, which represents an attempt made by American philanthropists to prove the capacity of the negro race for self-government. Founded in 1820 by the American Colonization Society, it was organized as an independent state in 1847 and acknowledged first by England and other nations of Europe and by the United States in 1861. The constitution of the republic is copied from that of the United States and the right of suffrage is inalienable to every male citizen who owns real estate. As no while man can be admitted to citizenship, and as none but citizens can hold real estate, the republic is in absolute control of men of the African race. It is a fairly prosperous country but is heavily loaded with debt and has been constantly torn by political disorder. Executive power is vested in a president and legislative power in a senate and house of representatives. In the southern part of Africa the Boers of Dutch origin founded two republics. The Orange Free State was established by Boers who in 1836 and following years quitted Cape Colony in order to separate themselves from British rule there. In 1854 the independence of the republic was declared and a constitution proclaimed. The legislative authority is vested in a single popular assembly elected by the suffrage of adult white males having property qualifications. The president is elected by universal suffrage. Similar to the history of the establishment of the Orange Free State is that of the South African Republic, known also as the Transvaal. It was formed by Boers who moved from Cape Colony and Natal and in 1852 its independence was acknowledged by Great Britain. A constitution was adopted in 1868. There was never lasting peace between the Transvaal

and its British neighbors to the south. In 1877 the country was annexed to Great Britain, but the Boers gained their freedom again under the treaty of 1881. Great Britain acquired suzerainty over the foreign relations of the republic in 1884. Friction between the two countries continued unceasingly and finally culminated in open war in 1899, which resulted in the defeat of the Boers and the addition of the republic to the South African possessions of Great Britain.

Duration of Republics.—It is not easy to set down in each case precisely the length of years that these republics have existed. Among historians there are differences, in most instances, as to the dates of beginning and ending. Some authorities date from the physical overthrow of a monarchy or other form of government preceding, others from the commencement of the struggle for popular rights, others from the adoption of a constitution and so on. Some accept as the end the accession of king or emperor, or the actual establishment of a new form of authority, while others hold that the republic really became non-existent before those events occurred to finally and formally mark its disappearance. Frequently the birth or the death of a republic has been a gradual development extending over many years, so that it is almost impossible to fix the exact time when it was fully fledged, or, on the other hand, had passed away completely. Some republics, noticeably those of South America and Central America, have had interrupted careers, republican rule in them being frequently suspended for a few months or even years, while dictators have held power although in form, at least, it has been practically continuous. Others have begun as members of a republican federation and later have been established entirely independent. Venezuela, Colombia and Ecuador were originally united in the one republic of Colombia; Guatemala, Honduras, Nicaragua and San Salvador were first members of a federal union. It is a disputed question whether such republics should be considered as dating from the beginning of the federation or from the beginning of their individual independence. In the appended table the former view is generally taken approximately then, the duration of life of the world's republics is as follows:

Israelitish Commonwealth	1491-1095 B. C.	396 years.
Grecian republic	700-146 B. C.	554 years.
Carthage	850-146 B. C.	704 years.
Rome	535-29 B. C.	506 years.
Lombard Communes	1183-1530	347 years.
Genoa	1000-1802	802 years.
Venice	600-1796	1196 years.
Amalfi	900-1135	235 years.
Free Cities of Germany	1241-1630	389 years.
Hamburg	1630-1905	275 years.
Lubeck	1630-1905	275 years.
Bremen	1630-1905	275 years.
Frankfort	1630-1810	180 years.
Iceland	928-1261	333 years.
The Netherlands	1609-1805	196 years.
French Republic I.	1792-1804	12 years.
French Republic II.	1848-1852	4 years.
French Republic III.	1871-1905	34 years.
San Marino	885-1905	1020 years.
Andorra	790-1905	1115 years.
Switzerland	1291-1905	614 years.
Liberia	1820-1905	185 years.
Orange Free State	1854-1905	51 years.
South African Republic	1830-1903	54 years.
United States of America	1776-1905	129 years.
Mexico	1824-1905	81 years.

REPUDIATION

Venezuela	1819-1905	86 years.
Colombia	1819-1905	86 years.
Ecuador	1819-1905	86 years.
Peru	1821-1905	84 years.
Bolivia	1825-1905	80 years.
Paraguay	1811-1905	94 years.
Argentina	1810-1905	95 years.
Uruguay	1825-1905	80 years.
Chile	1810-1905	95 years.
Guatemala	1823-1905	82 years.
Honduras	1823-1905	82 years.
Nicaragua	1823-1905	82 years.
San Salvador	1823-1905	82 years.
Costa Rica	1821-1905	84 years.
Brazil	1889-1905	16 years.
Hayti	1804-1905	101 years.
San Domingo	1844-1905	61 years.
Cuba	1903-1905	2 years.
Hawaii	1894-1905	11 years.
Panama	1903-1905	2 years.

Of these 46 republics 31 were in existence in 1905. Taken altogether, history shows that these nations have been as stable, prosperous, influential and powerful under republican forms of government as under monarchical or other form. No dynasties can compare in years of existence with the 12 centuries of Venice, the 11 centuries of Andorra, and the 10 centuries of San Marino. Few can show longer life than the republics of Israel, Carthage, Greece, Rome, Genoa, Switzerland and the Hanse cities of Germany. The ancient republics of Greece, Carthage, Rome, Lombardy, Venice and Genoa were the greatest nations of their times. In art, literature, law, commerce, all that goes to make up the best of modern civilization, they led the world for more than a thousand years, and left a heritage of good for all mankind coming after them, such as can be credited to no monarchy. The death of those that have gone out of existence was not, as is claimed by some, due to defects peculiar to the republican form of government. It came about naturally from the condition of things in the civilization of the earlier centuries. Men were warlike in those days, unrestrainedly contentious and regardless of the rights of others; public and private affairs were turbulent; class distinctions were sharply defined. Under such conditions all governments were, for the most part, short lived. Monarchies and oligarchies suffered as well as others. One after another they rose and disappeared, and none of them, until comparatively recent centuries, endured as long as the republics that were contemporary with them or that succeeded. The older republics deteriorated in public spirit toward the end; they were torn by internal dissensions; they became the prey of extravagance, dissolution and idle wealth within their borders, while jealous neighbors constantly sought to plunder and destroy or subjugate them. But these were dominant evils of the day in all lands and it stands to the credit of republican institutions that, despite disintegrating forces constantly at work, they existed long and splendidly. In modern times the story has been much the same. Only Great Britain, Germany, France, Italy, Austria, Denmark and two or three smaller monarchies can show results comparable with contemporary republics, and in those countries constitutions have given the people almost as much voice in public affairs as in a republic. Even in South America and Central America where government is still more or less chaotic and uncertain, the republics are in every way an improvement upon the despotic rule of Spain

that they succeeded. The first French republic was undisguised anarchy; the second was merely in comparison, a temporary flurry, but the third suffered in no wise with the most brilliant decades of the French kingdom or empire. The United States of America, under republican form of government, in all that goes to make up a great nation, has advanced to the forefront of world powers. Brazil has been as well governed in the decade and a half of its republican existence as it was even under the last Dom Pedro, most beneficent and most democratic of monarchs. The lesson to be drawn from the history of these republics from that of Israel to those of Cuba and Panama is that men are able to govern themselves well. The dangers and the evils that may threaten the republic have always been and are now the dangers and the evils inherent to the period, and threatening to any government, republican or otherwise. The elasticity of republicanism, permitting of easier adaptation to changing conditions and readier conformity to the needs of the people, gives it an advantage over the more rigid monarchy. That the general trend of the 19th century was toward republicanism cannot be questioned. Nearly half the republics that history tells of were started then and all of them are now in existence. The republican drift has been felt in other countries, as Spain, Portugal and Italy, for example, although it has there been overcome by hereditary authority. At the beginning of the 20th century more than one-half of the territory that is included in the civilized world belonged to republics and fully one-third of the population in all the civilized countries lived under republican rule.

Repu'diation, originally an American term, now used in all English-speaking countries, signifying the refusal of a national or state government to pay real or alleged pecuniary obligations. Nearly all leading countries have, at some time in their history, repudiated indebtedness. England has never repaid money borrowed for public uses from a Florentine merchant by one of the Edwards, and prominent London bankers were ruined when Charles II. confiscated their funds deposited in the royal exchequer. France redeemed the paper money called assignats at one thirtieth of its value. The United States failed to redeem the Continental currency. In the disastrous financial period of 1840 and several subsequent years, the States of Illinois, Indiana, Pennsylvania, Maryland, Mississippi, Michigan and Louisiana suspended payment of interest on their debts incurred in promoting public improvements, but all of them, except Michigan, Mississippi, and Louisiana, eventually fulfilled their obligations as to the capital of the debt. Governor McNut of Mississippi advocated "repudiating the sale of certain of the State bonds," on account of alleged fraud and illegality in the issue, and this was the origin of the term "repudiation" as applied to that course on the part of a State. The legislature of Mississippi refused to accept the governor's suggestion, but while the bonds were not formally repudiated, they were not redeemed. Michigan provided for the repayment of money actually received, repudiating obligations shown to have been issued without a fair equivalent, even

REPULSION — RESACA

although in the hands of innocent parties. Louisiana paid her creditors in depreciated State bonds. Minnesota refused to honor certain railroad bonds guaranteed by the State, in 1858, claiming that the railroads had failed to comply with the conditions on which the guarantee was given. The question of paying this indebtedness was agitated for many years, and finally in 1880 Minnesota compromised by agreeing to pay 50 cents on the dollar.

After the Civil War the Southern States fell under the rule of unscrupulous white men known as "carpet-baggers," intruders from the North who took advantage of the prostrate condition of the Southern whites to obtain control of the State governments with the aid of ignorant negroes. In some instances, also, white natives of the South shared in the carnival of plunder and oppression. Obligations were issued for which no reasonable equivalent ever reached the State treasuries, and the impoverished communities, when the native whites obtained supremacy again, found themselves deeply in debt. Georgia, Virginia, North Carolina, South Carolina, Florida, Alabama, Mississippi, Louisiana, Arkansas, and Tennessee, either scaled their debts to a figure which represented value received, or refused to pay obligations alleged to be tainted with injustice and corruption. Under the 11th Amendment to the National Constitution States cannot be sued by individuals, and creditors are therefore powerless to attempt collection in the courts. The repudiated obligations of the Southern States are mostly locked up in Northern safes, being held by persons who hope that at some period in the future the States in question may follow the example of Minnesota, and decide, notwithstanding alleged fraud and illegality, to redeem the promises to which the State seal is affixed.

Spanish-American republics, with some honorable exceptions, have persistently ignored their financial obligations. An attempt by France, England, and Spain, to collect debts due by Mexico, was the cause, or more correctly the excuse, for the ill-fated effort to establish an empire in Mexico, with Maximilian on the throne. Since the growth of Mexico in prosperity and position among the nations, under the beneficent despotism of Diaz, the Mexican government has voluntarily taken steps to meet its financial obligations. Venezuela's indifference to foreign claims led to the blockade of Venezuelan ports in 1902-3 by Germany, Great Britain, and Italy, and The Hague Tribunal decided in February 1904 that the nations who took part in these warlike proceedings were entitled to preferential treatment in the settlement which Venezuela had agreed to make with all her creditors. This decision caused much dissatisfaction on the part of the United States government, as it was apprehended that it would encourage the collection of debts by European powers from the weaker American republics by violent methods.

Repulsion, in physics, the force which compels certain bodies or their particles to recede from each other. No repulsion exists between bodies at sensible distances, except when they are in certain electric or magnetic states, in which case the repulsions between them are in the inverse ratio of the square of the distance. At insensible distances, some influence keeps the

particles of a body from being in absolute contact, whence results the phenomenon of elasticity. The motions produced by heat are also a cause of strong molecular repulsion. The molecules of gases are always in a state of mutual repulsion.

Reputed Ownership, in law, is a phrase used of one who has to all appearances the right and actual possession of property. "The false credit raised by a person exercising all the rights of ownership over a subject not his own has led to the adoption of the rule that the creditors of the reputed owner may take the subject as if it were his own." See **BANKRUPTCY**.

Requeña, rā-kā'nā, Spain, town in the province of Valencia, 40 miles west of Valencia. The remains of the tower of the ancient church of San Salvador; the castle towering above Las Cabrillas (a prominent summit), and the ruins of walls which formerly surrounded the city, are the chief points of architectural interest. The chief industry consists in the culture of silk, saffron, grain, fruit, and wine. Pop. 14,500.

Reredos, rēr'dös, in church architecture, usually the screen back of the altar, which is adorned with sculptured work comprising the tabernacle, niches, statuary, and the like; in some great cathedrals, for example, in England, the cathedrals of Durham, Winchester, and St. Albans, the reredos is a mass of most elaborate carving which reaches nearly to the graining.

Res Judicata, rēz joo-dī-kā'tā, a law term meaning that the subject matter of an action has been already decided by a court of competent jurisdiction. A matter so decided cannot again be made a ground of action between the same parties.

Resaca, rā-sā-kā, **Battle of**. While the armies of Gens. Thomas and Schofield were threatening an advance from the north on Dalton, Ga. (q.v.), Gen. Sherman ordered Gen. McPherson, commanding the Army of the Tennessee, to move southward through Snake Creek Gap and interpose between Dalton and Resaca. McPherson moved from Gordon's Springs 8 May 1864, his advance bivouacked that night in the Gap and next morning pushed through it, defeated a brigade of Confederate cavalry at the eastern end of it, and approached to within a mile of Resaca, on the Oostanaula, where he found the enemy in position too strong to be attacked; and being unable to find a good road by which he could quickly reach the railroad, north of Resaca, and fearing an attack upon his own left flank, he prudently withdrew, after some severe skirmishing, and took a strong position near the east end of Snake Creek Gap. Sherman now resolved to transfer the greater part of his army to join McPherson. Howard's Fourth corps and a small force of cavalry were to demonstrate on Buzzard Roost Gap and occupy Confederate attention north of Dalton. On the 10th Hooker's Twentieth corps moved through Snake Creek Gap and joined McPherson. Palmer's Fourteenth corps and Schofield's Twenty-third corps followed, and on the 12th the whole army, except Howard's corps and the cavalry with it, was through the Gap. On the morning of the 13th McPherson, preceded by Gen. Kilpatrick's cavalry, led the advance on the direct road to Resaca. Thomas, with the corps of Palmer and Hooker, was to

RESACA DE LA PALMA — RESECTION

move on McPherson's left, and Schofield on the left of Thomas. The country was covered by dense forest, and the movement of troops was difficult. Kilpatrick drove the Confederate cavalry to within two miles of Resaca, and was wounded, and his cavalry wheeled out of the road, allowing McPherson to pass, who, encountering the Confederate pickets near Resaca, drove them in and occupied a range of bald hills, his right on the Oostanaula, about two miles below the railroad bridge, and his left abreast the town. Thomas came up on McPherson's left and faced Camp Creek. Schofield worked his way through dense forest and came up on the left of Thomas, but it was noon of the 14th when these movements were completed, at which time Howard's Fourth corps, following Johnston from Dalton, had reached a position about a mile north of Schofield's left. Johnston abandoned Dalton about midnight of the 12th, and during the 13th formed his army covering Resaca, Polk's and Hardee's corps west of the place, facing west and covering the railroad bridge and a trestle bridge. Polk rested his left on the Oostanaula, and Hood's corps, on the right of Hardee's, extended across the railroad to the Connesauga, facing to the northeast. Wheeler's cavalry was on the right, and Jackson's cavalry, on the left, guarded the Oostanaula from Resaca to Rome. There had been severe skirmishing on the afternoon of the 13th between the troops of McPherson and Polk, and it was renewed on the morning of the 14th, and in the afternoon McPherson carried a bridge on Camp Creek, crossed it, and secured a commanding position very close to Polk's main line and intrenched. Confederate efforts to retake the position were repulsed. Farther to the left Palmer's Fourteenth and Schofield's Twenty-third corps became severely engaged with Hardee on Camp Creek, parts of Schofield's corps were repulsed with great loss, another part succeeded in making a lodgment beyond the creek. Two divisions of Howard's corps, coming in from the north, were sent to Schofield's support, leaving Stanley's division in echelon to the left. Hooker's corps was sent to the left. Johnston had noted the exposed position of Sherman's left and ordered Hood, with the divisions of Stewart and Stevenson, to attack and turn it. Late in the afternoon Hood attacked Stanley, outflanked him, and was driving him back when the advance of Hooker's corps, Williams' division, came up, repulsed Hood and drove him back to his intrenchments. Skirmishing was resumed along the entire line on the morning of the 15th, and Sherman ordered an advance of Hooker on the left, and the two divisions of the Twenty-third corps were withdrawn from the centre and marched to the extreme left in support. It was after noon when Hooker advanced, Butterfield's and Geary's divisions on the right and centre, and Williams' on the left. Hood, with the divisions of Stevenson and Stewart, supported by three brigades from Polk's and Hardee's corps, made a simultaneous advance from his works. Stevenson on his left was struck first by Butterfield and then by Geary, before he had gone far from his works, and after a severe fight was driven back to them, leaving a four-gun battery in advance of his line, which remained between the two lines until night, when it was secured

by a detachment of Geary's division. On Hood's right Stewart's division swung to the left, drove Williams' skirmishers from the railroad and, crossing, assaulted Williams' main line most vigorously, but was bloodily repulsed and fell back to its intrenchments. A part of Schofield's corps on Hooker's left took part in this engagement. Hooker's loss was over 1,600. On the 14th Sherman had ordered a pontoon-bridge to be thrown across the Oostanaula at Lay's Ferry, in the direction of Calhoun, and Sweeny's division of the Sixteenth corps was ordered to cross it and threaten Calhoun. Sweeny crossed one brigade, drove some Confederate cavalry from the opposite bank, then hearing that the Confederates were crossing above him, he withdrew the brigade and retired his entire division half a mile to a less exposed position. On the morning of the 15th he moved back to the river and crossed it, laid a pontoon-bridge, and constructed works. Here he was fiercely attacked by Walker's Confederate division, which was repulsed. The presence of a part of Sherman's army east of the Oostanaula determined Johnston to retreat, and that night he abandoned Resaca and marched for Calhoun. Sherman occupied Resaca on the morning of the 16th and started in pursuit. The Union loss at Resaca was about 600 killed and 2,147 wounded. The Confederate loss was about 300 killed, 1,500 wounded, and 1,000 missing. Consult: 'Official Records,' Vol. XXXVIII.; Cox, 'Atlanta'; Van Horne, 'History of the Army of the Cumberland,' Vol. II.; Sherman, 'Personal Memoirs,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.; Johnston, 'Narrative of Military Operations.'

E. A. CARMAN.

Pesaca de la Palma, ră-să'kă dă lă päl'mă, Texas, a ravine in Cameron County; four miles north of Brownsville. On 9 May 1846, an engagement took place here between 2,300 Americans under General Taylor, and 5,000 Mexicans under General Arista. The Americans were victorious; their loss was 39 killed and 83 wounded. The Mexican loss was 200 killed, 228 wounded, and 100 missing. Consult: Howard, 'Life of General Taylor'; Bancroft, 'History of Mexico.'

Re'script, the term applied in Roman law to the answers of popes and emperors to questions in jurisprudence propounded to them officially. The rescripts of the Roman emperors constitute one of the authoritative sources of the civil law. These were usually addressed to the provincial magistrates, to corporations, or even to individuals. The rescripts of Justinian admitted into the code have acquired great authority. The rescripts of the popes concern principally theological matters.

Rescue, or **Schrader's Brome Grass**. See GRASSES IN THE UNITED STATES.

Resection, in surgery, the operation of cutting out the diseased bone of a joint. It frequently obviates the necessity of amputating the whole limb, and by the removal of the dead parts leaves the patient a limb which, though shortened, is in the majority of cases better than an artificial one. Resection, which is one of the triumphs of modern surgery, became a recognized form of surgical operation in 1850.

RESERVATION OF THE EUCHARIST — RESERVE

Reservation of the Eucharist, the keeping of the sacramental species against emergent occasions, as the communion of the sick in their homes, for the Mass of the Presanctified on Good Friday, for the rite called Benediction of the Blessed Sacrament, and for perpetual adoration. Mention is made in authors of the times immediately following the apostolic age, of the custom of bishops sending to one another the Eucharist in token of Christian union and fraternity. St. Ambrose (4th c.) tells of the Eucharist being carried by lay persons; in the Middle Ages this custom was still in vogue. Thomas à Becket carried the Eucharist with him when he went to meet Henry II. and Saint Louis carried the sacred species with him on his crusade. The sacred host is now customarily reserved in all Catholic churches whether of Latin or Oriental rite, being kept usually in the tabernacle of the high altar in the Latin Church, and in Greek churches in a special receptacle, *artophorion*, behind the altar: whenever it is reserved, a lamp is kept ever burning before it.

Reservation, Mental, in moral theology and ethics, the withholding from speech words that are necessary to convey the sense in which the speaker wishes his interlocutor to take his words: in general, Mental Reservation is the using of words in a sense other than that which is obvious and which the speaker knows they are likely to convey: this is commonly called equivocation. Is Mental Reservation or equivocation ever lawful? The obligation to speak truth is acknowledged by all moralists, Catholic and Protestant alike; all theologians agree in the cardinal doctrine that it is never lawful to lie. But, mental reservation or equivocation has the same effect as lying: can resort, then, be made to equivocation without sin? "Almost all authors," answers John Henry Newman (*Apologia*, Appendix.), "Catholic and Protestant, admit that *when a just cause is present*, there is some kind or other of *verbal misleading*, which is not sin." The Catholic casuist is bound by authoritative decisions of the Roman See to hold that equivocations and mental reservations that *cannot be perceived* by the hearer are forbidden by the law of God: but nearly all Catholic moralists teach that sometimes a mental reservation is lawful, which may be, though very likely will not be, understood from the circumstances: on this ground a priest may deny that he knows of a crime which he has learnt through sacramental confession. Newman mentions various modes of verbal misleading which have received the sanction of moralists: one is the straightforward way of saying the thing that is not, as when one gives false direction to one who intends murder; authors hold that veracity is a kind of justice, and therefore when we have no duty of justice to tell truth to another, it is no sin not to do so. Another defense of certain untruths resorted to for just cause is, that veracity is for the sake of society, and, if in no case we might lawfully mislead others, we should actually be doing society great harm. On the other hand, certain strict moralists hold that all equivocations are in their nature lies, and therefore under no circumstances may we without sin equivocate. And then there is the rough-and-ready way of dealing with lies, namely, that of admitting that on a great or cruel occasion a man cannot help telling a lie, and he would not be a man did he

not tell it. "This view cannot for a moment be defended," Newman remarks, "but, I suppose, it is very common."

Reservation, Papal, of Benefices, the taking of the bestowal of certain church benefices and dignities out of the hands of the local church rulers and the attribution to the Roman Pontiff of the right to confer the same; or, what amounts to the same thing, the requiring of bishops, chapters and other persons or ecclesiastical bodies possessing the right of conferring benefices, that in case of vacancies they should bestow such benefices on persons nominated by the Pope. One reason alleged in favor of this practice was that thus the several national churches were linked more closely by personal ties of gratitude and affection to the central see, and through it to each other; another was that thus the Supreme Pontiff was provided with the means of rewarding those who had labored meritoriously in the cause of the Holy See and the Church Catholic.

Reservations, Indian. When the settlers from Europe came to realize that the Indians had human rights, and ought not to be enslaved or exterminated, the rule was generally adopted of confining the tribes to reservations, both for their own protection from unprincipled whites, and for the security of the white population. New York, Massachusetts, Connecticut, Rhode Island and other States enforced this policy in the colonial period and after independence, and the United States government has carried it out from an early date. Southern tribes east of the Mississippi were removed to the Indian Territory, designated by solemn pledge of the National government as a permanent home for their race, and there some of the tribes have achieved a high degree of civilization, and gained considerable wealth. They are largely intermarried with whites, and to some extent with negroes, whom they formerly held as slaves. Other tribes, chiefly from the Southwest, have been gathered into the Indian Territory, but large Indian reservations, mainly of Sioux, are still maintained in the Northwest, and altogether the various tribal reservations in the different States and Territories number about 185. The reservations are carefully guarded against intrusion by unscrupulous whites, and provision is made for the intellectual and physical welfare of the Indians, and for leading them to adopt civilized methods of self support, instead of depending on the chase, which now offers only the most precarious returns, or on government aid, which, however, is not withdrawn under any circumstances while an Indian is in need of it. The sale of intoxicating liquor to Indians is severely punished when detected, but the law is frequently evaded.

Reserve, in military affairs, has several significations. In battle the reserve consists of those troops not in action, and destined to supply fresh forces as they are needed, to support those points which are shaken, and to be ready to act at decisive moments. Napoleon's guards, and his disposition of them, are models. They often decided the victory when the enemy felt sure of success. The reserve of ammunition is the supply of warlike stores placed close to the scene of action to allow of the supply actually in the field being speedily replenished.

The term reserves is also applied to those

RESERVED CASES — RESHT

forces which are liable to be called into the field on great emergencies, for the purposes of national defense; which have received a military training but follow the ordinary occupations of civil life, and do not form part of the standing army. Such reserves now form a part of all national troops organized on a great scale. The militia of the various States is practically a reserve force for the National Government in the event of war.

Reserved Cases, in the canon law of the Roman Catholic Church, certain sins the power of absolving from which is reserved to the ecclesiastical superior himself—the pope, the bishop, the ruler of a monastery or other religious house. The “faculties” conferred regularly on priests who administer the sacrament of Penance do not extend to reserved cases, and the penitent must sue personally or through an intermediary for absolution by the pope, bishop or other superior to whom the case is reserved. Bishops have the right to limit the absolving power of those who under them have cure of souls, but in the United States this right is seldom exercised, and the “faculties” accorded in this country to rectors of churches and other *confessarii* is practically as large as that possessed by the ordinaries themselves.

Reservoir, a receptacle for storing water for any purpose, but more commonly for supplying cities and towns, feeding canals, driving machinery, and the like. The construction of a reservoir is of much importance, and requires great engineering skill. In the selection of a site the great object should be to choose a position which will give the means for collecting a large supply of rainfall with as little recourse as possible to artificial constructions. An advantageous site would be, for instance, in the narrow gorge of a valley through which a stream passes, and at a place where the gorge widens out on the side looking toward the source of the stream. Particular care, however, is necessary to discover whether the position chosen communicates with the courses of underground waters or springs, as disastrous results have frequently been occasioned by ignoring this. As a general rule the best and safest method is to establish reservoirs in valleys filled in with clays derived from the decomposition of the primary formations, which are very slightly permeable. The embankments or dams may be constructed either of masonry or earth-work, the latter being generally the more economical method. Where the reservoir requires to be constructed on perfectly level ground the excavation should be calculated so as to equal the embankment. The earth-work of dams should be as much as possible of material—such as a mixture of clay and gravel—which would resist the infiltration of the water: but as it is impossible always to obtain such material in sufficient quantities, engineers have recourse to a device which consists in the construction of a kind of wall termed a *puddle-wall*, formed in the middle of the embankment. This wall is constructed of well-worked clay, the foundation of the puddle being a trench dug down to impervious rock or clay, and its breadth should be on an average about one third the height of the embankment. The inside slope of the embankment is usually 1 perpendicular to 3 horizontal, sometimes it is steeper; the outside slope is 1 perpendicular to 2 horizontal; and

the height above the surface of the water is 4 to 7 feet. The earth-work ought to be constructed of thin layers, carefully rammed so as to secure their equal settlement; the inner face requires to be protected by stones in order to resist the action of the water. The waste-weir, to admit of the surplus water flowing over, should be from 4 to 6 feet below the surface line of the embankment, built of strong masonry-work, and of a width such that with a flow of 2 feet over the crown it should be able to discharge all the water brought down by the severest floods ever known to fall upon the basin supplying the reservoir. Many of the accidents that have occurred were due to deficiencies in the waste-weirs. In the reservoirs of which the dams are built of masonry there is no necessity for a waste-weir, as then the water may be allowed to overflow the wall, there being no fear of its endangering the work. The outlet at the bottom, by which the water to be used is drawn off from the reservoir, may consist either of a tunnel, culvert, or iron pipes provided with suitable sluices, and these should be so constructed that access may be had to them even when the reservoir is full.

The true principles for the proportioning of masonry dams were not thoroughly investigated until about the middle of the 19th century and subsequently. This was first done by French engineers, and many such dams have since been constructed in France, Algeria, the United States, etc. The highest of all such dams is that of the New Croton reservoir, New York, its height being 248 feet; thickness at bottom, 185 feet; at top, 16. The first great masonry dam built in France on the newer principle was that of Furens (1860-5); height, 184 feet; thickness at bottom, 162; at top, 11. The San Mateo reservoir dam near San Francisco, is 170 feet high; thickness at bottom, 176; at top, 20. The Periyar dam, India (1890-5), has a height of 173 feet; bottom thickness, 139; top, 12. In the famous reservoir of Alicante, Spain, executed 1579-94, the wall is 67 feet thick at the top, 112 feet at the bottom, and the height 141 feet. In England the preference is generally given to earthen dams. Sometimes natural lakes are used as reservoirs, instances of which are Loch Katrine, for the water supply of Glasgow, and Lake Thirlmere, in Cumberland, for the supply of water to Manchester. Distributing reservoirs for towns are generally built of masonry, but are sometimes of iron. They ought to be placed high enough to command the highest part of the town, and ought to be capacious enough to contain half a day's supply, their chief use being to store the surplus water during the night. Among notable modern storage reservoirs for towns are those of the Vyrnwy, for supplying Liverpool, containing 11,900 million gallons; Vehar (10,800 million gallons), for Bombay; San Mateo (31,000 million gallons), for San Francisco; and the New Croton (32,000 million gallons), for New York.

Resht, rësht, Persia, capital of the province of Ghilan, 150 miles northwest of Teheran, near the Caspian Sea, and with a port at Enzeli. On the highway of commerce and travel between Europe and Persia, its geographical position has a special significance. There is an extensive manufacture and trade in silk. Pop. about 40,000.

RESIDENCE — RESISTANCE

Residence, the place which a man regards as his home, even although he may be absent from it for long periods of time. In the United States the question of residence is of the greatest importance, involving citizenship, the right to vote, marital relations, questions of taxation, and of the disposition of property by will or inheritance. It has therefore frequently engaged the attention of the courts, and the decisions have not been uniform. As a rule a man is assumed to reside where his family have their home, provided he is not separated from them by law, and provided they have not refused to accompany him to a fitting residence elsewhere. When a man has a summer and a winter home, the question of residence is usually determined by his personal declaration, and his payment of personal taxes in the place which he elects to call his residence. Courts regard with suspicion and disfavor change of residence for the obvious purpose of obtaining a divorce, and New York courts have refused in several instances to recognize divorces granted in States to which citizens of New York had removed in order to take advantage of liberal divorce laws. Altogether the question of residence is far from being governed by any settled decision, but honest intent as shown by a frank and open course of conduct is usually respected by courts of law in passing upon the issue. See also *HOUSE*.

Resin. See *ROSIN*.

Resin Weed. See *COMPASS PLANT*.

Resistance, Electrical, that property of electrical conductors in virtue of which the passage of a current of electricity through them is necessarily accompanied by the dissipation of a part of the energy in the form of heat. It is manifested not only in a linear conductor like a wire, but also in solids of large extent in two or three dimensions, as when a current passes from one point to another of a sheet of metal, or of a mass like an ingot or casting. It is chiefly in connection with wires, however, that electrical resistance is of practical impor-

tance. The energy of the moving current of water is gradually dissipated in the form of frictional heat, and the energy of the moving current of electricity is similarly dissipated on account of the electrical resistance of the conductor through which it is passing. The unit in terms of which resistance is measured is the "ohm," which may be taken as sensibly equal to the resistance of a column of mercury 106.3 centimetres long and one millimetre in cross-section, at the temperature of freezing water. (For a more exact statement on this point, see *UNITS*.) The phenomena of electrical resistance have been studied, both mathematically and experimentally, by many eminent physicists; but the most important contributions to our knowledge are due to Georg Simon Ohm (for whom the "ohm" was named), and to James Prescott Joule. Ohm investigated the manner in which the flow of electricity through a conductor depends upon the resistance of the conductor, while Joule determined the law that governs the dissipation of energy from a conductor, in the form of heat. In the following exposition of the laws of Ohm and Joule, it will be assumed that the currents in the conductors are steady, that the electro-motive forces in the circuits are constant, and that the conductors are stationary (so that their coefficients of induction remain constant). The laws may still be applied, though in a somewhat more generalized form, to conductors in which these three conditions are not fulfilled; but for the proper understanding of the phenomena in such cases, it is necessary to refer to the more advanced treatises on electricity.

One of the results of Ohm's investigation was, that in a branched circuit, in which the resistances of the two branches are precisely equal, the current divides in such a manner that exactly one half of it traverses each branch. By taking advantage of this fact, we can determine the resistance of a proposed conductor in the following manner: Let R , in Fig. 1, be the resistance to be measured, and let this be

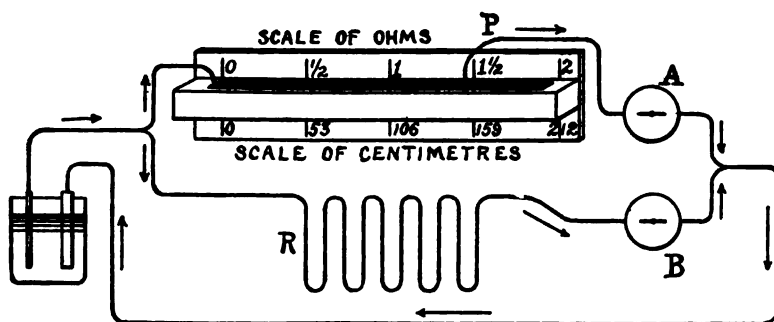


FIG. 1.

tance, and it is only in this aspect that the subject will be here considered.

The passage of a current of electricity through a wire or rod has been likened to the flow of a current of water through a pipe, the water corresponding to the electricity, and the friction between the water and the pipe to the electrical resistance of the wire. The analogy is not perfect, but it is certainly very useful in forming a good conception of electrical resis-

tance. The energy of the moving current of water is gradually dissipated in the form of frictional heat, and the energy of the moving current of electricity is similarly dissipated on account of the electrical resistance of the conductor through which it is passing. The unit in terms of which resistance is measured is the "ohm," which may be taken as sensibly equal to the resistance of a column of mercury 106.3 centimetres long and one millimetre in cross-section, at the temperature of freezing water. (For a more exact statement on this point, see *UNITS*.) The phenomena of electrical resistance have been studied, both mathematically and experimentally, by many eminent physicists; but the most important contributions to our knowledge are due to Georg Simon Ohm (for whom the "ohm" was named), and to James Prescott Joule. Ohm investigated the manner in which the flow of electricity through a conductor depends upon the resistance of the conductor, while Joule determined the law that governs the dissipation of energy from a conductor, in the form of heat. In the following exposition of the laws of Ohm and Joule, it will be assumed that the currents in the conductors are steady, that the electro-motive forces in the circuits are constant, and that the conductors are stationary (so that their coefficients of induction remain constant). The laws may still be applied, though in a somewhat more generalized form, to conductors in which these three conditions are not fulfilled; but for the proper understanding of the phenomena in such cases, it is necessary to refer to the more advanced treatises on electricity.

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means of the movable wire P , whose point of contact with the mercury can be shifted to the right or left, at will. The measurement consists in moving the point P until the two galvanometers A and B , one in each branch of the circuit, show that the currents in the two branches are precisely equal. We then know that the resistances in the two branches are also equal. In preparing the engraving it has been assumed that the equality has been observed to subsist when that part of the mercury column which is included in the circuit is 159 centimetres long, and therefore has a resistance of 1.5 ohms. If the galvanometers and connecting wires are identical in both branches, it therefore follows that the resistance of the coil R is also 1.5 ohms. The method of measuring resistances here described is presented in order to illustrate the fundamental idea of electrical resistance. In the practical measurement of resistances a more refined method, presently to be described, is employed.

It is found that the electrical resistance of a linear conductor of uniform cross-section is proportional (1) directly to the length of the conductor, (2) inversely to the area of its cross-section, and (3) directly to a certain numerical factor characteristic of each material, and which is called the "specific resistance" of the material. The specific resistance of a given metal varies to a certain extent with the physical condition of the metal. The following values are for annealed specimens, except in the case of lead and zinc, where pressed or extruded metal is understood; and the resistance of mercury has been taken as unity in each case. The temperature is also assumed to be that of freezing water, in every instance.

SPECIFIC RESISTANCES OF METALS.

Mercury	1.0000
Silver	0.0158
Copper	0.0168
Gold	0.0216
Aluminum	0.0306
Zinc	0.0592
Platinum	0.0952
Iron	0.1022
Nickel	0.1310
Lead	0.2063

In practice, mercury columns are not used as standards of resistance, because they are not convenient to manipulate. The mercury column is selected as defining the "ohm" for general purposes, because it is easy to obtain mercury in a state of purity, and also because all questions of internal stress and physical state in general are eliminated by the use of a fluid standard. An isolated observer, for example, who wishes to construct a resistance of one ohm for experimental purposes, can do so readily enough by preparing a column of pure mercury of known length and cross-section. He can then compute the resistance of this column, at the freezing point of water, and in this way he can obtain a standard of considerable accuracy. In practical work, however, it is customary to employ, as standards of resistance, coils of wire that are wound upon spools or bobbins. These are standardized either by comparison with other coils whose resistances are known, or by direct comparison with a mercury column of known dimensions and assured purity. A bobbin that is wound with wire as an ordinary

spool is wound with thread possesses a considerable coefficient of self-induction if the length of wire is at all great; and this tends to impair its efficiency as a standard, because in the practical measurement of resistance it is desirable to have the self-induction of the standard as small as possible. Standard resistance coils are therefore wound in a special way, with the idea of reducing the self-induction as much as possible. One half of the wire is wound about the central core (or spool) in one direction, and the other half is wound in the other direction; so that if an iron core were placed in the axis of the spool, and a current were sent through coil, the magnetic effect upon the central iron core would be zero. By this device, the self-induction of the coil may be rendered negligible.

The resistance of a conductor varies to some extent with temperature; and while the magnitude of the variation differs with different metals, and even with the physical state of any one metal, it may be taken, roughly, as increasing by about 0.21 of one per cent, for each Fahrenheit degree of rise of temperature, for copper and silver and several of the other pure metals. The resistance of liquid mercury increases much more slowly with temperature, the coefficient of mercury being only about one fifth of that stated above. The resistance of carbon diminishes as the temperature rises. In accurate electrical work it is evidently essential, in view of the variation of resistance with temperature, either to keep the temperature of the standard coils constant, or to ascertain the coefficient of variation of resistance with temperature with considerable care, so that a suitable correction may be applied for any departure of the temperature of the standard coils from the one temperature at which their resistances are accurately known. In practice it is usual to determine the temperature coefficient with as much accuracy as possible, and then to keep the temperature of the coil as near as practicable to the temperature at which it has been standardized. Any error in the determination of the temperature coefficient will then have but small effect upon the calculated resistance of the standard. Many attempts have been made to prepare alloys which shall have negligible temperature coefficients; and while no alloy has been found whose electrical resistance is absolutely independent of the temperature, several have been prepared whose temperature coefficients are quite small. German silver is one of the commonest of these alloys, the composition of that which is used in the preparation of resistance wire being (by weight) 4 parts of copper, 2 of nickel, and 1 of zinc. The specific resistance of this alloy is about 13 times that of copper, and its temperature coefficient is only about 0.022 of one per cent, per degree Fahrenheit. "Platinum-silver," as used for electrical resistance standards, is composed of two parts (by weight) of platinum, to one part of silver. It has a specific resistance about 15 times as great as that of copper, and its temperature coefficient, per Fahrenheit degree, is only about 0.017 of one per cent. "Manganin" has largely come into favor for electrical resistance standards during the past few years, the composition recommended by the Reichsanstalt being (by weight) 84 per cent of copper, 12

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per cent of manganese, and 4 per cent of nickel. Its specific resistance is about 20 times that of copper, and its temperature coefficient is only about 0.0013 of one per cent, per Fahrenheit degree, at ordinary temperatures; the coefficient diminishing as the temperature rises, until, at about 113° F., the coefficient becomes rigorously zero. At still higher temperatures, the coefficient of manganin becomes negative; but at all temperatures it is so small that it can be neglected for all purposes save those in which the highest attainable degree of accuracy is required.

In the accurate measurement of electrical resistances, the device known as "Wheatstone's bridge" is employed. Ohm's law, which is one of the most fundamental principles in the science of electricity, states that in any circuit of constant form, in which a constant electromotive force is acting and a uniform current is flowing, the current, resistance and electromotive force are connected by a simple mathematical relation, which may be expressed in the following manner: Let any two points in the circuit be selected, and let R be the resistance included between these points, as expressed in ohms. Let E be the electromotive force between these same points, as expressed in volts; and let C be the current between them, in amperes. Then the

relation in question is $C = \frac{E}{R}$, or $E = CR$.

To apply this principle to the measurement of resistances, let A and B , in Fig. 2, be the two

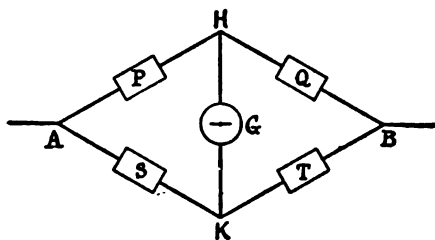


FIG. 2.

points selected, and let the circuit be divided at these points, into the two branches AHB and AKB ; the resistance of AH being P , while that of HB is Q , that of AK is S , and that of KB is T . The points H and K are to be connected, later, by means of a conductor, HGK , carrying a galvanometer, G ; but for the moment the conductor HGK is assumed to be non-existent. Let us suppose that the difference in electromotive force between A and B is E , while that between A and H is e . Then Ohm's law, when applied to the branch AHB as a whole, gives $E = C_1(P + Q)$; C_1 being the current flowing through the branch AHB . Similarly, when applied to the section extending simply from A to H , Ohm's law gives $e = C_1P$. Eliminating C_1 from these two equations, we find that e , the electromotive force between the two points A and H , is equal to $EP/(P + Q)$. In the same way we may show that the difference of electromotive force between A and K in the branch AKB is equal to $ES/(S + T)$. If the electromotive force between H and K is zero, then these two expressions are equal, and we have $P/(P + Q) = S/(S + T)$, which is equivalent to $Q/P = T/S$, or to $PT = QS$. If H and K are connected by a branch con-

ductor that includes a delicate galvanometer, G , then the galvanometer will indicate a current except when the electromotive force between H and K is zero; that is, it will show a current whenever the relation $PT = QS$ is not fulfilled. This arrangement of branch circuits, with a galvanometer bridging across from one of the branches to the other, constitutes "Wheatstone's bridge." Its use for measuring resistances may be illustrated as follows: Let Q and T be two known resistances, and let P be the unknown resistance, whose value is to be determined. At S we introduce a "resistance box," which is merely a box containing an assortment of known resistances, so arranged that any or all of them can be conveniently thrown into the circuit or out of it. The resistance S is varied by trial until the galvanometer G ceases to show a deflection; and when this condition is fulfilled, we know that the equation $PT = QS$ holds true. But we knew Q and T to start with, and we have determined S by trial; so that we know three of the four resistances that enter the foregoing equation, and we can therefore calculate the fourth. Resistances may be determined, in this manner, with exceeding accuracy. (Consult, for full details, W. A. Price, 'Treatise on the Measurement of Electrical Resistance'.)

One practical application of Ohm's law relates to the arrangement of the cells of a battery, so that the current goes through all of the obtained in a given circuit, by the use of a fixed number of cells. If the zinc electrode of one cell is joined to the carbon electrode of another, a compound element is thereby formed, which has twice the electromotive force of a single cell, and whose internal resistance is also twice as great as the resistance of one cell. Similarly, if n cells be arranged in series, so that the carbon of each is connected to the zinc of the next, and so that the current goes through all of the cells consecutively, the electromotive force of the battery will be nE (where E is the electromotive force of one cell), and the resistance of the battery will be nr (where r is the resistance of one cell). If the terminals of this battery be connected by means of a wire whose resistance is R , the total resistance of the circuit so formed will be $R + nr$; and hence the current through the circuit will be (in accordance with Ohm's law)

$$\text{Current} = \frac{nE}{R + nr}$$

If R , the resistance of the external part of the circuit, is very small, it is evident that the current will not be very different from E/r ; that is, if the external resistance is very small, the current sent through it by the battery of n cells arranged in series, will not be greatly different from the current that would be obtained by the use of a single cell. But if R is very large, so that nr is negligible in comparison with R , then the current through the external circuit becomes sensibly equal to nE/R , which is approximately n times as great as the current that a single cell would send through the given external circuit. When the resistance of the external circuit is great, therefore, the maximum current is obtained by arranging the cells of the battery in "series," as described above.

If the n cells are arranged so that all of

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the carbons are connected together to form one electrode, and all the zincs are connected together to form the other one, then the electromotive force of the battery is the same as that of a single cell. That is, it is r/n . The external internal resistance of n cells arranged in this way, however, is only one n th of the resistance of a single cell. That is it is r/n . The external resistance being R , as before, the total resistance of the circuit is $R + r/n$, and hence the current in the external circuit is

$$\text{Current} = \frac{E}{R + r/n}$$

If the external resistance, R , is large, then r/n will be negligible, and the current becomes practically E/R , which is approximately equal to the current that a single cell would send through the same large external resistance, R . On the other hand, if the external resistance, R , is very small, R may be negligible with respect to r/n , and in that case the current through the external resistance becomes nE/r , which is sensibly n times as great as the current that a single cell of the battery would send through a very small external resistance. When the resistance of the external circuit is very small, therefore, the maximum current through it is obtained by arranging the cells of the battery "in parallel"; — that is, so that all of their carbons are connected to form one positive electrode, and all their zincs are connected so as to form one negative electrode. In general, it may be shown that the maximum current that any given battery can produce through a given conductor, is realized when the cells are so arranged that the effective internal resistance of the battery is as nearly equal as possible to the external resistance through which the current is to be sent.

The quantity of energy dissipated in the form of heat when a current traverses a conducting circuit was investigated by Joule, and also by Lenz, Becquerel, and others. It is found that the quantity of heat-energy set free in any given conductor in one second is proportional (1) to the resistance of the conductor, and (2) to the square of the current that is flowing. If the resistance of the conductor is R ohms, and the current is C amperes, then the quantity of heat generated in T seconds will be $0.238 C^2 R T$ calories; the "calorie" being defined as the quantity of heat required to raise the temperature of one gramme of water from 14°C. to 15°C. This is often called "Joule's law."

A. D. RISTEEN, PH.D.,

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Resolution Island, the name of several islands, the principal one being in British North America, at the extreme end of Hudson Strait; lat. $61^\circ 39' \text{N.}$; long. 65°W. The island is about 40 miles in length and breadth, and Cape Resolution is on the east side. Resolution Island, in Dangerous Archipelago, Pacific Ocean, is in lat. $17^\circ 22' \text{S.}$, long. $141^\circ 35' \text{W.}$ Resolution, a lagoon island in Low Archipelago, is in lat. $17^\circ 25' \text{S.}$, long. $143^\circ 24' \text{W.}$

Resolutioners, a designation of party which had its origin in Scotch church history. When the Scotch with their covenanted king, Charles Stuart (Charles II.) had been defeated by Cromwell at Dunbar (13 Sept. 1650), the

Scotch parliament repealed an act under which royalists were excluded from the army. The repealing act was approved by a large majority of the Scotch Kirk as being wise and politic in the circumstances, but it was reprobated by a small but zealous minority in the Kirk as a betrayal of the true interests of religion; this party was known as that of the Protestors, the other party as that of the Resolutioners; each of the two maintained that it was itself the genuine Scotch Kirk, the only church that remained faithful to the Covenant and to the church's head, Christ.

Resolutions of '98, the designation commonly given to the Kentucky and Virginia resolutions of 1798, defining the relations between the State and Federal governments, and protesting against certain acts of Congress as unconstitutional, and as violating the rights reserved to the States. The Resolutions offered in the Kentucky legislature, and adopted by that body, were drafted by Thomas Jefferson, who, in common with other leading American statesmen, and the majority of the people, was alarmed by the enactment of the Alien and Sedition Laws, and other measures regarded as indicating a purpose to create a centralized despotism in place of the Union formed under the Constitution.

The first Resolution declared that the Federal Constitution was a compact between the States, by which a general government was created for special purposes, and that, "as in other cases of compact between parties having no common judge, each party has an equal right to judge for itself, as well of infractions as of the mode and measure of redress." The Alien and Sedition and other laws were pronounced "not law, but altogether void and of no force," and one of the Resolutions postponed to "a time of greater tranquillity" the "revisal and correction" of other acts of Congress alleged to be unconstitutional.

The eighth Resolution directed the appointment of a committee of correspondence, to communicate the Resolutions to the several States, and to inform them that the State of Kentucky was determined "to submit to undelegated and consequently unlimited powers in no man or body of men on earth; that in the case of an abuse of the delegated powers, the members of the general government being chosen by the people, a change by the people would be the constitutional remedy; but when powers are assumed which have not been delegated, a nullification of the act is the right remedy; and that every State has a natural right, in cases not within the compact, to nullify of their own authority all assumptions of power by others within their limits." The Committee of Correspondence was instructed to request the other States "to concur in declaring those acts void and of no force, and each to take measures of its own for providing that neither these acts, nor any other of the general government, not plainly and intentionally authorized by the Constitution, shall be exercised within their respective territories."

The Resolutions passed the Kentucky legislature, 14 Nov. 1798, with only two or three dissenting votes, and similar Resolutions, drafted by James Madison, were adopted by the Virginia legislature, 24 Dec. 1798, by a vote of 100 to 63

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in the House of Delegates, and 14 to 3 in the Senate. The fact that both Jefferson and Madison were afterward elected Presidents of the United States, and that the Democratic party, which they represented, remained in power for many years, has been accepted as indicating that the Kentucky and Virginia Resolutions had the substantial approval of the American people. See UNITED STATES.

Resonance, a strengthening of sound. When a person speaks in an empty room the walls reflect the words. There is an echo from each wall; and when the person is not equidistant from the different reflecting surfaces the echoes strengthen one another, and strengthen the sound. Resonance includes such strengthening of sound as occurs when a sounding-board is used to strengthen the note from a string or the note of a tuning-fork, or when the air contained in an open-mouthed vessel is made to vibrate and strengthen a particular note.

Resorcin, or **Resorcinol**, a chemical substance having the formula $C_6H_4(OH)_2$, and therefore belonging to the group of phenols (q.v.). It may be regarded as derived from benzene, C_6H_6 , by replacing two of the hydrogen atoms by two hydroxyl radicals. Three substitution compounds of this character are possible (see AROMATIC COMPOUNDS), and all three are actually known. Catechol (or pyrocatechin) is the "ortho" di-substitution product; resorcin is the "meta" di-substitution product, and quinol (or hydroquinone) is the "para" di-substitution product. Resorcin was first prepared by Hlasiwetz and Barth, in 1864, by fusing galbanum resin with caustic potash. It is now prepared commercially by fusing caustic soda with the sodium salt of benzene-meta-disulphonic acid; this acid being itself prepared by the action of fuming sulphuric acid upon benzene. The resorcin that is formed is abstracted from the solution so obtained by agitation with ether, or with some other substance in which the resorcin is soluble, but which does not itself mix with water; and after isolation in this manner, the resorcin is purified by distillation or otherwise. Resorcin is soluble in water, in alcohol, in benzene, and in ether, and is insoluble in carbon disulphide and in chloroform. From water, alcohol and ether it crystallizes in trimetric tablets, and from benzene it is obtained in the form of needles. Pure resorcin is colorless, but upon exposure to the air it becomes reddish. It melts at $244^\circ F.$, and boils at about $520^\circ F.$ Resorcin, like ordinary phenol (or carbolic acid), is largely used in the manufacture of the coal tar colors (q.v.), and it is also used extensively in medicine. It has marked antiseptic properties, and is used in the treatment of skin diseases in washes, ointments and salves. It is also administered internally, though less commonly.

Respiration. The essential process in respiration is the taking in of oxygen and the giving out of carbon dioxide by the living cells of a plant or animal. In higher animals special organs, the lungs (q.v.), and a special tissue, the blood (q.v.), are the main factors in this exchange; but in the lower animals lungs are not necessary, and in plants, as well as in many of the lower animals, there is no true blood. Even in those higher animals in which the major

part of the oxygen exchange takes place in the lungs (external respiration), there is also an internal respiration constantly taking place in the exchange between the blood, the lymph, and other tissues. Respiration in plants is of the same general character as in animals. It is not to be confounded with the much more active process of photosynthesis, by which plants utilize carbon dioxide and give off oxygen, a process which was termed respiration by the older plant physiologists.

Historical Summary.—The earliest naturalists and philosophers, Aristotle and others, even down to the anatomists of the 15th century, taught that the function of respiration was to draw air into the arteries and heart, and thus to cool the blood. The old Galenic doctrine was that the "air introduced by breathing served to regulate, to maintain, and at the same time to temper, to refrigerate the innate heat of the heart." Again the pumping action of the thorax introduced into the blood the air which was necessary to generate the vital spirits in the left side of the heart, and finally the same pumping action got rid of the foul vapors, the product of the innate fire burning in the heart. Harvey was one of the first to show that the same channel probably did not serve to carry these two different currents. But the chemical problems involved were too intricate for Harvey, although it was chiefly through the work of a group of Englishmen of the 17th century that the unraveling of the mystery of respiration came about. Von Helmont had taught a theory of fermentations, and he had noted the difference in color in blood passing through the lungs. Borelli approached the mechanical side of the problem and showed the truth regarding the mechanics of the chest, the bellows-like action of which took in by atmospheric pressure and expelled the air by the muscular relaxation and the elasticity of the chest-walls. Malpighi had in the meantime discovered, with the aid of his crude microscopes, the minute structure of the lung, and Borelli, as well as others (Hooke, 1667; Croon and Boyle, 1666), working with the newly discovered principle of the air-pump and vacuum, had learned that air was absolutely essential to the life of the animal, and had advanced to the point that the particles of the air taken into the lungs enter into and become mixed with the blood. But Borelli was a physicist, and had no sympathy with the new chemical learning, which was then a very vague subject. Hooke and Lower made the next steps possible, the former by his artificial-respiration experiments, proving the necessity for air, and the latter by his careful transfusion experiments, demonstrating that the difference between dark venous blood and lighter arterial blood was due to the admixture of air, thus explaining this color change, which had been recorded for thousands of years and referred to thousands of causes. Up to this time it had always been thought that the air was a simple substance, and not a mixture. John Mayow (1643) first showed that not all of the air was used by the lungs in influencing the blood, but only a certain part; and although he called it by a different name (nitro-aerial gas), it was that part now known as oxygen. Mayow thus developed the first full adequate physico-chemical theory of respiration. He saw that respira-

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tion was a process analogous to combustion, and that the movements were to take in the nitro-aerial gas and give out the vapors arising from the blood. But he did not know at all what these vapors were. He had grasped at the meaning of the intake, but had no knowledge of the exchange products. This and other wonderful discoveries were made by a young man of 25, and who died at the age of 34. Mayow's work was then forgotten for almost 100 years. As Foster expresses it, "that which in the first years of the latter half of the 17th century as igneo-aerial particles shone out in a flash and then died away again into darkness, in the last years of the 18th century, as oxygen, lit a light which has burned, and which has lighted the world with increasing steadiness up to the present day." The names of Stahl, Haller, Boerhaave appear as keeping alive the study of respiration. Stephen Hales, an active parish priest, and the earliest sanitarian, was an ardent student of chemistry. He first enunciated the principle of free and combined gases, and led the way to the work of Joseph Black, who rediscovered Von Helmont's "fixed air," which was given off by the lungs, and that animals placed in the "fixed air" died much as if they were deprived of fresh air. The next step was made by Priestley, who in 1772 rediscovered Mayow's "igneo-aerial" spirit and isolated oxygen. Priestley's views, however, were permeated by the century-old phlogiston theory, and it remained for Lavoisier clearly to demonstrate what oxygen really was and to overthrow the phlogiston theory. Thus the problem of animal respiration was solved. The air, composed mostly of innocuous nitrogen and of small proportions of active oxygen, passes into the fine air vesicles, first seen by Malpighi, the blood there takes up the free oxygen, giving off carbon dioxide, which exchange constitutes the essential feature of respiration. It should be added that it was not until Gustavus Magnus (1837) proved the presence of the blood-gases in different proportions in the blood that the present theory of respiration assumed a definite form. The study of the relation of the iron of the hæmoglobin in the blood to this oxygen exchange constitutes the last chapter in the unraveling of this secret of nature.

Mechanics of Respiration.—Breathing consists in the rhythmical expansion and contraction of the walls of the chest, by means of which process air passes into the lungs and thus comes in contact with the blood. The lung structure itself possesses no marked expansile power, but it is in a constant state of tension, there being negative pressure in the pleural cavity. The muscles attached to the ribs, including the diaphragm (q.v.), expand the cavity of the chest in all three diameters by raising the ribs and lowering the diaphragm; the air rushes in and inflates the lungs; the muscles then relax, the elasticity of the ribs causes the chest-wall to contract, the lungs themselves contract somewhat and the air is forced out through the bronchi and larynx. Thus it is evident that the lungs themselves are merely passive agents in inspiration, being filled and emptied of air largely in consequence of the movements of the chest-wall. The control of the muscular movements is partly voluntary and partly involuntary, and the breathing centre so called is in reality a

complex one, or rather a series of centres, all co-ordinated. Thus the motor centres for certain muscles attached to the ribs are located in the spinal cord, and their excitation can bring about restricted movements of expansion, while their destruction may result in paralysis of certain of the muscles of respiration. Another breathing centre, the most important one, spoken of as the automatic or true respiratory centre, is found in certain ganglion cells in the floor of the fourth ventricle of the medulla oblongata (q.v.). Their destruction destroys the co-ordination of the muscular movements, and brings about death. A third centre is present in some portion of the fore brain, probably in the frontal lobes. It is this centre that enables one to "hold the breath," or to make extra deep breaths, etc. The distinction between conscious and unconscious breathing is very distinct and yet very subtle. Voluntary influences constantly modify the rate of breathing. While one is asleep these conscious influences are usually temporarily excluded, and then the so-called normal rhythm is seen. This is usually from 18 to 20 to the minute in the adult, the ratio of length of inspiration to that of expiration being about 10 to 12. Numerous individual variations may be present, however, the rate varying from infancy to old age, and in diseased conditions the rate is nearly always modified, usually quickened in consequence of the increased oxidation that often accompanies disease. Occasionally respiration is slowed when there is painful breathing, or some form of poisoning; opium-poisoning is a noted illustration. In this condition the breathing rhythm may sink as low as 4 to 5 to the minute. In children of both sexes the movement of breathing are similar, but as adult conditions develop, and changes in dress become pronounced, it happens that women are more apt to breathe more in the chest (costal breathing), while men make more use of the lower ribs and the diaphragm (diaphragmatic or abdominal breathing). The amount of air taken into the lungs varies widely with the size of the individual, the shape of his chest, and a number of other factors that make it impossible to give a general average. It is usual to measure that portion of air that passes in and out of the lungs during normal respiration as tidal air; this has been known to be from 150 to 700 cubic centimetres. In forced breathing a certain extra amount of complemental air can be taken into the chest; its average being about 1,500 cubic centimetres. A certain amount of air (residual air) cannot be expelled from the chest even by forced expiration. This has been found to vary in amount from 400 to 1,500 cubic centimetres. The vital capacity, or the amount of air which can be expelled from the thorax by forced expiration following a deep inspiration—a spirometer, or the "lung-tester" of the circus, being the instrument for measuring the same—varies very widely according to practice, height, weight, and age. For the comparative anatomy of respiration, see ANATOMY, COMPARATIVE, *Respiratory System*.

Artificial Respiration.—When death is imminent, owing to a cessation of the natural respiration movements, it may sometimes be averted by an imitation of them carried on regularly for a while. Such a condition may occur in disease (for example, asthma, epilepsy), though very rarely; it is most common in suffocation, either

RESPIRATOR — RESSEL

by drowning, choking, or strangulation, and is sometimes met with also in poisoning by noxious vapors (for example, carbonic acid, carbonic oxide, coal-gas, chloroform, etc.). In order that any method may have a chance of being successful it is of course necessary that the entrance of air into the lungs be not impeded, whether by a piece of food or by water in the windpipe, or by the tongue falling back and closing the upper opening. A piece of food may sometimes be removed through the mouth by the finger; if this fails, the windpipe should be opened. In those apparently drowned the body should first be laid on the face, with the head low, and the thorax and abdomen be pressed on in order to expel fluids which may have been drawn into the trachea and bronchial tubes. The tongue may need to be held forward; this may be done by an assistant; or an elastic band passed round the tongue and the chin will effect the object. No general consensus of opinion has yet been arrived at as to which is the best method of producing artificial respiration. The methods most employed fall into three divisions: (1) insufflation, or blowing of air into the lungs, either by the mouth or by means of bellows; (2) manual methods, in which external manipulations of the chest-walls are made to effect the entrance and exit of air; (3) electrical stimulation of the respiratory muscles. In all cases where artificial respiration is required every moment is of importance. It is doubtful whether life can ever be restored when the heart has ceased to beat for more than a few seconds; and when breathing has stopped failure of the heart's action is always imminent. That method is therefore best which can be applied with the least possible loss of time, so that under ordinary circumstances the methods which require bellows or electric batteries are out of the question. Direct insufflation, or blowing of air into the patient's lungs by the mouth applied to his mouth, is now hardly ever used except in the case of very young children, although within recent years specially devised pumps have been made that are at times very serviceable. Of the manual methods those most in use are Marshall Hall's (1856), Silvester's (1857), and Howard's (1877). The second is certainly the most easy to learn, but is more fatiguing to carry out for a length of time than either of the others. In Marshall Hall's method the body is laid upon its face and rolled "in what may be termed cradle-fashion" from this position on to one side and a little beyond it (inspiration), and then back on to the face (expiration). In Silvester's method the patient is laid on his back on a plane, inclined a little from the feet upward, and the shoulders are gently raised by a firm cushion placed under them, which also throws the head back. The operator then grasps the patient's arms just above the elbows, and raises them till they nearly meet above the head. This action imitates inspiration. The patient's arms are then turned down, and firmly pressed for a moment against the sides of the chest. A deep expiration is thus imitated. In Howard's method the patient is laid on his back with a cushion below the middle. The operator kneels astride his hips, places his hands with fingers spread outward over the lower part of the chest-wall, and alternately bends forward, throwing his weight on the chest to imitate expiration, and

springs back to allow the elastic recoil of the chest-wall to imitate inspiration.

Whatever method be adopted, the movements must be gentle, regular, and perseveringly carried on, at the rate of from 10 to 15 times in the minute; and when the faintest natural effort at respiration is observed they must at once be timed so as to reinforce and not to oppose it. In some cases life has been restored under artificial respiration when no respiratory movements have occurred for an hour or even several hours. In all cases, but especially in that of persons apparently drowned, artificial respiration should be conducted in a warm atmosphere, 90° F., or even more if possible, and should be supplemented by warmth applied to the body and by vigorous friction. In those apparently drowned recovery is very rare after complete immersion for as much as five minutes. If stunning or fainting has occurred at the moment of immersion, so that the respiratory movements have been annulled or much diminished for the time, less water will have entered the lungs, and the chance of recovery may be greater. In other modes of death by suffocation, such as choking or strangulation, the action of the heart may continue longer, and restoration to life be therefore possible after a longer deprivation of air. See ASPHYXIA; DROWNING.

Consult: Bert, 'Leçons sur la Physiologie comp. de la Respiration' (1870); Foster, 'Lectures on the History of Physiology' (1901); Schäfer, 'Text-Book of Physiology' (1901). See ANATOMY; HÆMOGLOBIN.

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Respirator, an instrument used as a mouth-covering to give warmth to the air inhaled into the lungs. They are also frequently employed to secure the inhalation of a medicated atmosphere, containing a layer of lint or wool on which a few drops of terebene, eucalyptol, or other antiseptic are placed.

Responden'tia, a term now seldom used, but meaning a loan raised by the master of a ship, when he has no other means of doing so, upon security of the cargo or goods on board the ship. The contract has reference to a particular voyage, and the conditions are that if the subject on which the money is advanced be lost by sea, risk, or superior force of the enemy, the lender shall lose his money; and that if the goods arrive in safety the loan shall be repaid with a greater than ordinary rate of interest, called marine interest. When the ship itself is hypothecated the contract is called bottomry. As a matter of fact the expression bottomry is employed, whether the vessel or her cargo or both be the security.

Ressel, rës'sël, **Joseph**, Austrian inventor: b. Chrudim, Bohemia, 29 June 1793; d. Laibach, Austria, 10 Oct. 1857. He was educated at Vienna and at Mariabrunn, and from 1817 until his death was employed in the Austrian Department of Forestry. He was skilled in mechanics and invented several machines. His claim to the invention of the screw-propeller seems as well founded as those of Ericsson, Sauvage, Smith, and Wilson, but owing to an accident on the trial trip of his invention he failed to secure a patent. Consult Reitlinger, 'Joseph Ressel' (1863).

REST-CURE—RESTORATION

Rest-cure, a method of treatment advocated by Dr. S. Weir Mitchell in 1875 for cases of nervous prostration and various conditions characterized by poor blood, and lack of muscular and nervous tone. It is a systematic treatment extending over several weeks, a combination of absolute rest of body and mind, regular diet at fixed hours, a separation from relatives and friends, passive exercise by massage, the use of electricity, and the supervision of a trained nurse. The use of medicines is of secondary importance, but frequently of value. As Dr. Mitchell puts it, the rest-cure is of service to "invalids, unable to attend to the duties of life, and sources alike of discomfort to themselves and anxiety to others." Consult Mitchell, 'Fat and Blood' (1877).

Restarick, Henry Bond, American Protestant Episcopal bishop: b. Somersetshire, England, 26 Dec. 1854. He studied at the King James collegiate school in Bridgewater, England, and after coming to this country was graduated from Griswold College, Davenport, Iowa. He took priest's orders in the Episcopal Church in 1882, was rector of St. Paul's Church, San Diego, Cal., 1882-1902, and in July of the last named year was consecrated the first American bishop of Honolulu. He has published 'The Love of God'; 'Addresses on the Seven Last Words.'

Restigouche, *rës-tî-goosh'*, a river of Canada, in its lower course separating New Brunswick from the province of Quebec, and flowing northeast into the Bay of Chaleur at Dalhousie. It rises in eastern Quebec, is 225 miles long, is navigable for 16 miles to Campbellton, and forms a tidal estuary for 24 miles. It drains 6,000 square miles, and its basin supplies great quantities of timber.

Restitutionists, a Christian religious sect in New England whose distinguishing tenet is that the restoration of mankind to the condition from which he lapsed through Adam's sin of disobedience is near at hand, and that the reign of perfect love, justice, purity, and holiness is soon to commence. They observe the Sabbath of the Hebrews as a holy day of rest and assemble weekly for worship on the evening (Friday) before the Sabbath.

Restoration, in matters of fine art, the putting of a building, a work of sculpture, a painting or other work of art into what is thought to have been its original perfect condition. There is, however, a secondary meaning which is often used in a way to cause confusion: this is the preparation of drawings showing what, in the opinion of the draughtsman or his director, would be the appearance of the building or other work of art if restored according to the above definition. The term "conjectural restoration" is applied to these drawings, though all restoration is more or less conjectural, but the adjective is used in these cases because the drawings often represent much more complete and precise, and much less thoroughly verified statements concerning the original state of the work of art than those which are actually carried out.

To treat first of these suggestions for restoration embodied in drawings: Among the most useful in the way of architecture are some by Sibill, who continued the work of Letarouilly in his folio work on the Vatican in Rome, and

those by the well-known author and architect, Viollet-le-Duc, especially in the plates to 'Entretiens sur l'Architecture,' and in three or four large lithographs for display on the walls of schools and the like. These are based upon a very exact knowledge of the processes of building. There are some of singular interest in the work on the discoveries at Pergamon, by Pontremoli and Collignon ('Pergame,' Paris, 1900); in the kindred work on 'Epidaurus' by Defrasse and Lechat, Paris, 1895; also in a three-volume book called 'La Restauration d'Olympie' by Laloux and Monceaux. In such drawings a building will be shown complete and in use, with figures near it and passing up and down its flights of steps, or seated on its stone benches. Life is given to the representation by landscapes fitted to the purpose, or by other carefully considered surroundings. In connection with these there should be mentioned also the models in plaster, the preparation of which is a serious art in Paris and in other great centres of artistic study. These models, when concerned with a non-existent building, may be a complete rendering of that building, as in the case of the model of the Parthenon and that of the Hypostyle Hall at Karnak, both at the Metropolitan Museum of Art, New York. In these there has been a bold attempt to show, as if definitely known, the entirely uncertain structure of the roof of the great temple, and also the painting on the same building, according to the theory of the accomplished architect who designed the model, the late Charles Chipiez: but the Egyptian temple has its paintings modified on account of modern notions of propriety. The model of the Pantheon at Rome, in the same collection, can be visited both within and without, and is more nearly trustworthy than that of the Parthenon. All of this, however, is conjectural restoration of excellent quality.

Restoration of buildings, when carried out in reality, is extremely open to error of the most mischievous sort, because it is never safe to assume that the last word has been spoken in the matter of demonstration of the building's original condition. We, in 1904, cannot for a moment accept the archaeological knowledge of our predecessors of 1860, and yet in the years following the middle of the 19th century nearly all the most important mediæval buildings of Europe were restored, and too often in a radical way. In too many cases the original character of the building is destroyed altogether, as in the famous instance of the Church of Saint Front at Périgueux, and in the case of the Fondaco dei Turchi at Venice, now the Museo Civico; but in a vastly greater number of cases the restoration has been conscientious and in a way judicious, but has still destroyed much that would be, had it been spared, the best possible evidence for the original study of the structure. It will be noted that the ambition of the official or committee in charge of a great building, religious or secular, is nearly always to have it as complete and elegant as may be; that this ambition is more than repeated in the architect whose reputation and pecuniary gain are closely connected with the great and costly undertaking; and finally that these ambitions find an echo in the opinions of the general public, who, of course, like to see the famous monument of their city put

RESTORATION

into first-rate order and kept as clean and perfect and bright-colored as the new buildings near. To this is added the actual demand for safety. Thus, in the case of the Ducal Palace at Venice, of which the restorations were carried on between 1881 and 1884, a conscientious desire to preserve the famous building intact was present in the mind of the controlling intelligence: but the great capitals of the lowermost arcade upon which the whole weight of wall reposes were in many cases found to be so split that they were unsafe. It may well have been thought with perfect honesty that the preservation of the building required their removal; they were removed and placed with all care in a hall of the building, while newly cut capitals were put in their place. St. Mark's was more hardly treated, for the exquisite marbles with which the exterior was sheathed were carried off and replaced by slabs of a vastly inferior quality and color, a certain smoothness and a certain appearance of finish being thus got at the expense of the chromatic beauty of the original work. Nothing need be said of the mosaics, because they are always in a state of change, repairs and restorations going on all the time: but the change in the great floor of the church by which the singular waves and hollows which had marked it for so many years were all graded and the floor smoothed out into a glossy, modern pavement, excited at the time the greatest indignation on the part of many, and can hardly be satisfactorily criticized; there being so much doubt as to the true cause of the old inequalities.

There is still another difficulty in the restoration of buildings, namely, the introduction of later, though still early, details. Thus in a Gothic cathedral, especially in England, one whole bay of the north or south aisle will have been built up with 14th century windows, contrasting oddly with the "early English" fenestration of the neighboring bays. Shall the restorer respect these changes of an earlier time, or shall he sweep them all away and make the church that which, according to his best lights, it was in (say) 1195? It is evident that there is great room for disagreement as to this, and that no restoration of such building can ever satisfy the student altogether. It is evident that every precaution should be taken to save the old work and that the interests of fine art and archæology alike demand the preservation of every bit and scrap of building as it has reached us from antiquity, repairs being carried out only in so far as to save the ancient pile with all its details. At the same time excuses can readily be found for those who advocate a sweeping restoration: for, as they would say, the building was meant to be used and was meant to have a certain general aspect: is it not probable that we know enough to put it back to its original character? Unbelieving critics can never persuade these people of their own probable ignorance.

In sculpture the case is more simple. Until within the last 25 years an important antique statue was generally restored, and the most skillfully carried out restoration was perhaps that of the Ægina sculptures in the Glyptothek in Munich. These are said to have been directed by the celebrated sculptor, Bertel Thorwaldsen, and they have a wonderful appearance of verity, while at the same time no one can say how far

the surface of the marbles found in Ægina have been lowered in places to agree with the restoration. It has always been considered a wonderful piece of good fortune at a time too early for such intelligence in archæological matters—the preservation from restorations of the Venus of Milo in the Louvre, this preservation having been largely the result of disagreement. On the other hand, the finds of the years since 1870 are much more commonly preserved intact; no one will think of restoring the Hermes of Olympia. Even in our own time, however, such slight injuries as the breaking of two or three fingers in the Augustus of Otricoli in the Vatican, or in the Venus of the Capitol, are pretty certain to be repaired, but then it is the custom of all properly managed museums that a label shall hang on the pedestal with a full description of the additions made, and the catalogues of the better organized museums contain also such a mention in full.

In the matter of painting it has long been understood that there is only one safe way, and that is to refrain from bringing a brushful of paint anywhere near the canvas. The old picture has suffered certain injuries; it must not therefore be subjected to the greater injury of falsification. As late as 1885 paintings in several of the museums of Europe were undergoing repainting of the most radical sort. Any person who was looking into the matter at that time would miss from its place in a church or gallery some great canvas. If he were shrewd and bold he would get sight of that canvas set up against a wall on its side, or on its head perhaps, and there undergoing a process of repainting in sky or drapery at the hands of the most unintelligent operative who could use a palette and a painter's pencil. By and by the picture would be in its old place again, and then the few who look closely into a picture would feel that their old friend and inspirer was gone. The director of just such a restoration said to the writer that he was quite aware of the opinion of the foreign visitors that this ought not to be done—that only a patch of neutral color should be put in where an actual blister had existed—where color had left the canvas altogether—that, in short, the picture should be mended, but not repaired and renewed with an attempt to imitate its original surface. He was a good-tempered old gentleman, and made no pretense at artistic pride in his work, which indeed was going on at the hands of the most forlorn and careless copyists, but it was his work, for which his salary was paid. It was suggested long ago that every picture in a public gallery should have hung on its frame an exact account of what had been done to it and when—whether partial repainting or repairing of positive injuries, revarnishing, transferring from wood to canvas, or the like. This, however, has not been done as yet, and the student of the most precious paintings in the world is grievously handicapped by the primary difficulty of discovering what is really the artist's work and what is the ignorant tinkering of irresponsible moderns.

RUSSELL STURGIS.

Restoration, The, in English history a term applied to the accession of King Charles II., in 1660, after the civil war, to the throne of England, after an interregnum of 11 years and four months, from 30 Jan. 1649 (when Charles I. was beheaded) to 29 May 1660. In

RESTORATIONISTS—RESURRECTIONISTS

French history, the first restoration begins 3 May 1814, when Louis XVIII. made his entry into Paris under the protection of foreign bayonets, and ended with the return of Napoleon from Elba, 20 March 1815. The beginning of the second restoration is generally reckoned from the battle of Waterloo, 18 June 1815; and terminated on 29 July 1830, with the abdication of Charles X.

Restorationists, the followers of Origen in the opinion that after a certain purgation proportionate to their delinquencies all will be restored to God's favor and to paradise. In the Middle Ages, the Brethren of the Free Spirit held this doctrine; at the time of the Reformation, it was taught by the Anabaptists and in the 18th century by the Rationalists. See also UNIVERSALISM.

Resumption, the return to specie payment by a government. The Resumption Act of 14 Jan. 1875 fixed 1 Jan. 1879 as the day on which specie payments should be resumed by the United States government. Resumption actually took place on 17 Dec. 1878, when the premium on gold disappeared.

Resurrection, an article of belief contained in all the formularies of the Christian faith, namely, that at the last day all the human creatures that shall have lived on earth will rise from their graves in the bodies which they had in life. It is a doctrine peculiar to the Christian religion, one not entertained by the pagan nations of antiquity nor by the Hebrews till the latter period of their history as a nation. In the Hebrew scriptures are many passages which favor more or less the doctrine of the resurrection of the dead; but such passages are in no instance free from ambiguity; and even were it to be granted that they unequivocally assert a resurrection, they do not accord with the doctrine that is taught in all the creeds of Christendom, namely, that when the period of man's life upon the earth is closed then the entire human race, not the good alone, but the wicked, not the blest alone, but those also who are destined to everlasting punishment shall arise from the grave with the bodies which they had in life and appear before the supreme tribunal. The passages of Hebrew Scripture that have been regarded as intimating this doctrine are chiefly Isaiah xxvi. 19, Job xix. 23-27, and Daniel xii. 2. The passage of Isaiah, as rendered in the Authorized Version is, "Thy dead *men* shall live; *together with my dead body they shall arise.*" The words italicized are supplied by the translators. In the Septuagint the latter half of the passage is rendered, "and those in the graves shall arise." If this is unequivocally a declaration of the resurrection of the bodies of men, at least it does not assert that there will be such a resurrection of the entire human race. Job xix. 25-27 reads: "I know that my redeemer liveth and that he shall stand at the latter *day* upon the earth; and *though* after my skin *worms* destroy this *body*, yet in my flesh shall I see God: whom I shall see for myself, and mine eyes shall behold, and not another." Again a mutilated Hebrew text, with variant readings and variously translated in the versions: but granted that it tells of a resurrection on the last day, it says at most only that Job will then appear in his body as when he lived—one man, not all mankind.

Much clearer and stronger is the passage, Daniel xii. 2, "Many of them that sleep in the dust of the earth shall awake, some to everlasting life, and some to shame and everlasting contempt": this is explicit, but it does not say that *all* the dead will arise clothed in their bodies; and this becoming "awake" does not necessarily imply re-assumption of the bodies at all. Toward the time of the downfall of the Jewish nation the belief in the resurrection of the body was generally entertained among the Jews: in the apocryphal book 2 Maccabees the doctrine of the resurrection is strongly asserted, yet even there nothing is said about a resurrection of all the dead; and though the resurrection of all the dead is now the 13th article of the Jewish creed, it is a doctrine that cannot be proved from the Talmud or the Midrashim, according to which only the just will rise again. But in the books of the New Testament the resurrection of all on the last day is explicitly declared, and in all the formularies of Christian belief, beginning with the Apostles' Creed, this doctrine is most distinctly asserted. That not only the just but also the wicked shall rise again is explicitly taught by the Founder of Christianity in Matt. v. 29, x. 28, and particularly in John v. 28, 29, "The hour is coming in which all that are in the graves shall hear his voice, and shall come forth; they that have done good, unto the resurrection of life; and they that have done evil, unto the resurrection of damnation."—THE RESURRECTION OF JESUS CHRIST on the third day after his crucifixion is by Saint Paul made the very basis of Christian faith: "If Christ be not risen then is our preaching vain, and your faith is also vain." The evidence of the truth of Christ's resurrection, for those who were to form the first nucleus of his church was the fact that on eleven different occasions between the resurrection and the ascension into heaven he manifested himself to his apostles and others, his companions and friends: and these testify to the truth of this resurrection in clear, definite, positive statements. Those who deny the objective reality of Christ's resurrection—and it was denied in the very first age of the Church—attempt to explain it away on various grounds; but his disciples distinctly testified that it was Jesus himself, in corporeal presence, who conversed with them at sundry times during the 40 days preceding the ascension.

Resurrection, a novel by Leon Tolstoy, published in 1900. It presents in the author's strongest manner the theme of the development of a great character, besides offering a picture of Russian society, from the wealthy office-holding circle, to the peasants and common soldiers, jailers, and criminal classes. Nekhludoff, a noble, in the effort to right the wrong he has done to another, unconsciously rights the wrong done in himself by the false social outlook and inadequate education which had made him what he was, and constructs for himself a new and broadly human creed of living.

Resurrection Fern. See FERNS AND FERN-ALLIES.

Resurrection Plant. See ROSE OF JERICHO.

Resurrection Sisters. See ORDERS, RELIGIOUS.

Resurrectionists, or **Body-snatchers**, a class of miscreants who, in Britain previous

RESZKE — RETENTIVENESS

to the passing of the Anatomy Act of 1832, made a livelihood by rifling graves, taking out the corpses and selling them to schools of medicine and surgery as "subjects" for dissection or demonstration. So long as in Britain the supply of "subjects" from the gallows sufficed for the needs of the schools, there was no call for a resort to illegal means. But when, in the progressive reform of criminal law, capital punishment was less frequently inflicted, while medical and surgical schools were greatly multiplied, the necessity for "subjects" overrode the laws, and the trade of the resurrectionist flourished. As the schools were mostly in London, the graveyards in the vicinity of the metropolis were the main resource of the body-snatchers, with whom the grave-diggers and the caretakers were usually in league. As the business was naturally risky and precarious the price of "subjects" was, for each, \$40 to \$50. To protect the bodies of the newly interred, their graves would be protected with strong gratings, or spring-guns would be set at night, or the friends of the deceased would keep watch, armed, over the graves for several nights till the bodies had become unfit for use in the schools. These precautions made the business of the body-snatchers even more risky, and "subjects" would be sought in various localities throughout the kingdom. As the price paid by the doctors rose and the risk grew greater, it occurred to one Burke at Edinburgh to provide subjects for the dissecting table by killing people instead of violating graves. He was hanged at Edinburgh 28 Jan. 1829, convicted of having despatched 15 victims and sold their bodies to the doctors. The first Anatomy Act of the British Parliament (1832) provides that schools of anatomy and teachers and demonstrators of anatomy shall be licensed; such schools and such teachers are empowered to receive as subjects for dissection the cadavers of persons dying friendless, in poorhouses, hospitals, and elsewhere; and the trade of the resurrectionist was practically done away in Britain by the passage of the act. In the United States there are not in any of the individual States any statutes regulating the practice of anatomical dissection: the plundering of graves for subjects of dissection is a misdemeanor for which the offender may be indicted at common law. Instances are not very rare of the bodies of persons, not friendless, who die in public or quasi-public hospitals, being, without legal warrant, sold to the schools by subordinate employees of such hospitals. Body-snatching, or rifling of graves for the purpose of exacting a ransom from the families of the dead is not infrequent: a notable instance was that of the stealing of the body of the late A. T. Stewart in 1878. The body-snatchers in this case demanded a ransom of \$200,000, which afterward they reduced to half that sum: finally, they received \$20,000 with the assurance that they should not be prosecuted: since that time extraordinary precautions are taken against body-snatching from the graves, especially of very rich persons.

Reszke, řěsh'kě, Edouard de, Polish opera singer: b. Warsaw 23 Dec. 1856. He studied at the Collège de l'Agriculture of Proskao, and then turned attention to the cultivation of his remarkable bass voice. He appeared in Paris in 1876 at the Théâtre Italien, and since then has sung in the large cities of Europe and America.

He created the role of the King in Catalini's 'Edda' and Carlo V. in Marchetti's 'Don Giovanni d'Austria' at Turin. He is especially identified with Mephistopheles in 'Faust'; Frère Laurent in 'Romeo et Juliette,' and the Wagnerian roles of Hans Sachs, Wotan and King Mark.

Reszke, Jean de, Polish opera singer: brother of Edouard de Reszke (q.v.): b. Warsaw 14 Jan. 1853. He completed the law course at the Warsaw University; but having been surrounded by a musical atmosphere in his home, and having sung as a boy in the cathedral, he decided upon singing as a career. He studied with Ciaffei and Cologni in Italy and made his début in Venice in 1874 as Alfonso in 'La Favorita.' In the two following years he appeared in London and Paris. Hitherto he had sung baritone roles, but in 1876 he retired to cultivate his natural voice whose register was that of a tenor. In 1880 he reappeared, singing at Madrid in 'Robert le Diable.' Following this he created the part of Jean in Massenet's 'Herodiade' in Paris and was engaged at the Opera where he sang from 1885 to 1890, appearing in 'Le Prophète,' 'L'Africaine,' 'Aida,' 'Faust,' 'Romeo et Juliette,' 'Don Juan,' and 'Le Cid' which Massenet composed for him. From 1893 to 1899 he appeared continuously at the Metropolitan Opera House, New York, where he added to the foregoing roles several Wagnerian parts, particularly 'Siegfried.' In recent years he has been associated artistically with his brother Edouard.

Retaining Wall, a wall erected for the purpose of confining a body of water in a reservoir, or for resisting the thrust of the ground behind it. Without such a wall the earth would lie at a considerable angle off the perpendicular. The angle it makes with the horizontal is called the angle of repose, and varies with the nature of the material. The amount of resistance necessary to be afforded by the wall depends partly on the material and partly on the angle of repose. For the pressure against the wall is produced by the material filling the space between the angle of repose and the face of the wall; and the less this angle the greater the quantity of material required to fill the space, and the heavier the material the greater the pressure. It will hence appear that the great condition to be observed in the erection of these walls is that the sum of the forces tending to displace the wall shall be exceeded by the force tending to produce stability. As a general rule the thickness of retaining walls is made one third the height of the bank which they are intended to support. In estimating the requisite thickness of the wall, account must be taken of the different ways in which it may be displaced, as by overturning, slipping along its entire base, or the giving way of the upper parts while the base remains. In reservoir walls of masonry, the thickness should be made practically double that of ordinary earth retaining walls.

Retentiveness, a quality of memory by which the after-effects of mental processes are long held, with capability of reproduction. Retention is of primary importance in judgment, particularly in the study of processes that are continuous, or in which there is a continuity of interest. Thus when one hears a succession of sounds, and judges that the second, for instance,

is louder than the first, the property of retention, by which the after-effect of the hearing of the first sound is compared with the second, is of great importance. In many this attribute of retentiveness is weak, seriously impairing their judgment. See JUDGMENT; MEMORY AND ITS DISEASES.

Rethel, *rä'tël*, **Alfred**, German painter: b. Aix-la-Chapelle 15 May 1816; d. Düsseldorf 1 Dec. 1859. He studied at the Academy of Düsseldorf (under W. Schadow) and afterward at Frankfort (under Philip Veit and Schwind). Here he painted 'The Resurrection of Christ' (in the Church of Saint Nicholas), 'Daniel' (in the city museum), and 'Justice Pursuing a Fleeing Murderer.' When there was a competitive exhibition held of designs for frescoes in the town-house of Aix-la-Chapelle representing incidents in the life of Charlemagne, he was chosen to do the work, and lived to complete four of them; the other four being executed from his designs after his death. These are considered the finest productions of his brush. He painted in water-color a series of pictures illustrative of 'Hannibal's Passage of the Alps,' which were afterward reproduced by wood engraving. In 1848 he executed his 'Dance of Death'; and drew a number of designs on wood. His style was notable for grandeur and energy, and his frescoes are among the finest modern examples of that style in Europe. In 1852 he was seized with a nervous affection for which he sought relief by traveling, but died insane.

Retarius, *rê-shî-ä'ri-üs*, a netman, that is, a Roman gladiator who wore only a short tunic and carried a trident and net, with which he endeavored to entangle and dispatch his adversary, who was armed with helmet, shield, and sword.

Retina. See EYE.

Retreat, **Spiritual**, or **Retreat**, in devotional language, a season of retirement from ordinary secular occupations and of prayer, of meditation upon the truths of religion and the duties of the Christian life, of examination of conscience, of serious consideration of one's spiritual state, etc. The Retreat is also called the Spiritual Exercises, that being the name given to it by Saint Ignatius de Loyola, whose plan of the Exercises (*Exercitia spiritualia*) has ever since his day been the directory of the Spiritual Retreat. The Exercises are arranged for a retreat of 4 weeks, but usually the time is abridged to 10 days or a week. See EXERCISES, SPIRITUAL.

In military language, a retrograde movement, whether forced or strategical, by which troops retire before an enemy: it differs from a flight in being orderly and under control. An army in retreat must be covered by a powerful rear-guard, which from time to time must, if the enemy is pursuing, hold the pursuers at bay, while the artillery and the baggage pass defiles, cross streams or overcome any obstacles.

Retribution, in anthropology and in law: in anthropology the retribution theory expresses the belief in states of happiness or of misery in another world, allotted to men according to their deserts while living on earth. Tylor ('Primitive Culture,' ch. xiii.) does not find this idea existing universally in the religions of the lower range of culture that have not been affected by contact with higher religions. The

most primitive view of the life beyond the grave was, he holds, that it is simply a continuation of the present: to this succeeds the belief that excellence, valor, social rank, etc., modify circumstances and surroundings in the next life; out of this, he believes, was finally developed a doctrine of future rewards and punishments.—In law, the theory of retribution, or retributive theory is, that punishment is inflicted in retribution for an offense, and ought to be similar to the misdeed: this is the principle of the retribution prescribed in the Hebrew law—"an eye for an eye, and a tooth for a tooth." In modern legislation deterrence displaces retribution: it is held that no more punishment should be inflicted than suffices to deter others from committing the offense: even the death penalty is not defended on the principle of "Life shall go for life," but because with abandoned criminals capital punishment has a more deterrent effect than has life imprisonment.

Retriever, a dog, trained to find out and bring back any killed or wounded game. The two varieties of British retriever differ only in coat. The larger and more familiar breed of retrievers, the wavy-coated, is formed by crossing the Newfoundland and the setter; the smaller or curly-coated breed is formed by crossing the water-spaniel and the terrier. The typical retriever is 20 or more inches high, with a stoutly-built body, strong limbs, webbed toes, and black and curly fur. See DOG.

Returning Boards. All State governments have provision for the final canvass of votes in State elections by some central authority, known as a returning board, or by some similar designation. The duties of these boards are ministerial, and they have no right to go outside the face of the returns. In the Presidential election of 1876 the returning boards of Florida, South Carolina and Louisiana, controlled by the "carpetbag" and negro element, went behind the returns, and assumed to cast out sufficient votes on the ground of alleged fraud and intimidation to give those States to the Republican electors. A great ferment resulted, and in order to allay the agitation and arrive at a correct conclusion, an electoral commission was appointed, which decided in favor of the Republican candidate, Rutherford B. Hayes.

Retz, *rêtz*, **Rais**, *râz*, or **Rays**, *râz*, **Gilles de Laval de**, French military officer: b. 1404; d. 26 Oct. 1440. He was a Breton of high rank, and distinguished himself under Charles VII. in the struggle with the English, fighting by the side of the Maid of Orleans. Subsequently he received the baton of marshal. He retired to his estates, but was brought to trial by the Bishop of Nantes, charged with sorcery and the practice of cruelty in the celebration of demoniac rites. He was convicted and burned. Attempts were once made to find in Retz a historical original of Bluebeard, but, of course, in vain.

Retz, **Jean François Paul de Gondî**, **CARDINAL DE**, French politician: b. Montmirail 19 Sept. 1613; d. Paris 24 Aug. 1679. His instructor was the celebrated Vincent de Paul. In 1643 he received a doctorate at the Sorbonne, and was appointed coadjutor of the archbishop of Paris. Although preferring military service he found he could gratify his ambitions in the church and his impassioned eloquence won him the favor of the Parisians. Aiming at political

influence he incurred the enmity of Richelieu, and, after his death, of Mazarin. The Fronde, or the party opposed to the court and Mazarin, received the coadjutor as a man whose genius and popularity made him a valuable accession, and De Retz embraced their cause with zeal. The various insurrections of the people and the Frondeurs obliged Mazarin to leave France, whereupon De Retz seemed to have it in his power thenceforth to hold the reins of government. But Mazarin soon returned from his banishment, more powerful than ever. The Fronde, which had never been firmly united, and the members of which, with the exception of Condé and De Retz, were weak and wavering, was dissolved; and soon after the latter, not without the management of his enemy Mazarin, had obtained the cardinal's hat, he was unexpectedly seized and confined in the castle of Vincennes, whence he was subsequently removed to Nantes. Here he found means to escape, and, perpetually pursued by officers of Mazarin, wandered for eight years through Europe.

After the death of Mazarin in 1661 he was allowed to return to France, after having promised never to take part again in political combinations. He now resigned his archbishopric, governed the abbey of St. Denis, lived retired, restricted his wants, paid his immense debts, and distributed pensions to his friends. Reconciled with all parties he lived the retired and quiet life of a philosopher. His posthumous 'Mémoires' (1718) give an interesting picture of his character. The best edition of his works is that in the 'Grands Ecrivains de la France' series (1872-90). An abridged edition was published in 1865 in one volume. Consult: Chantelauze, 'Le Cardinal de Retz, Etude historique' (1878); 'Le Cardinal de Retz et ses Missions diplomatiques à Rome' (1819).

Retzsch, rētsch, **Moritz**, German artist: b. Dresden 9 Dec. 1779; d. Holflossnitz, near Dresden, 11 June 1857. As a painter his subjects were taken largely from German and Greek mythology and display beauty in drawing and color. Retzsch's illustrations of the great poets, comprehending the drawings executed by him for editions of Goethe's 'Faust,' and the works of Schiller and Bürger, have rendered him deservedly famous. He executed a 'Shakespeare Gallery' consisting of 80 plates. In 1824 he was appointed a professor in the Art Academy at Dresden. His illustrations of poetry and legend were done in outline and are distinguished by exquisite delicacy and refinement of form and expression.

Reuchlin, roin'lin, **Johann** (Hellenized KAPNIO), German Hebrew scholar and humanist: b. Pforzheim, Baden, 22 Feb. 1455; d. Liebrenzell 30 June 1522. The excellence of his singing procured him a place in the chapel of the Margrave of Baden, who appointed him traveling companion to his son Frederick, afterward bishop of Utrecht. In 1473 Reuchlin accompanied that prince to Paris, and there studied Greek under Hieronymus of Sparta, besides applying himself assiduously to Latin composition and Hebrew. In 1475 he went to Basel, and after some time spent in the study of Greek began to teach that language, with Latin and philosophy. At this time also he wrote his Latin dictionary, 'Breviloquus, id est Dictionarium singulas Voces Latinas breviter explicans'

(1478), the first published in Germany. In 1483 he went back to France, and studied law at Orleans, while he taught, at the same time, the ancient languages. In 1481 he returned to Germany, and taught law and the belles-lettres at Tübingen. Eberhard, count of Würtemberg, soon after took him, as the best Latinist in Germany, in his train on an embassy to Rome. The Emperor Frederick II. created him a noble of the empire in 1492. After Eberhard's death Reuchlin lived several years at the court of Philip, elector of the Palatinate. Here he enriched the Heidelberg library with manuscripts, and productions of the new art of printing. He was subsequently appointed president of the court of the confederacy which had been established by the Swabian princes against the encroachments of the house of Bavaria. He was also engaged in translating the penitential psalms, preparing a Hebrew grammar and dictionary, and correcting the translation of the Bible. A converted Jew, John Pfeffercorn, and Hoogstraten, an inquisitor, obtained from the Emperor Maximilian, in 1509, an order that all Hebrew works, the Old Testament only excepted, should be burned, on the ground that they were full of blasphemies against Christ. The emperor, however, consulted Reuchlin, who assured him that these works, instead of injuring Christianity, contributed, on the contrary, to its honor and glory, since the study of them produced learned and bold champions to fight for the honor of the Christian religion, and that to destroy these books would be to put arms into the hands of its enemies. The order was thereupon recalled, but a war of pens raged for ten years. Passages were extracted from Reuchlin's works and their meaning perverted; on the ground of which a charge of heresy was brought against him. He was summoned in 1513 before the Inquisition at Mainz, presided over by Hoogstraten, and by a decree of that tribunal his writings were consigned to the flames. This roused the indignation of the friends of classical literature, and an appeal was made to Pope Leo X., who referred the whole matter to the Bishop of Spire. That prelate declaring Reuchlin innocent, ordered the monks to pay the expenses of the investigation. A counter appeal was made by Hoogstraten; but Reuchlin was then acquitted by a commission of prelates held at Augsburg in 1516; and the pope issued a mandate that all proceedings against Reuchlin should be stopped. In the course of this contest appeared the 'Epistolæ Obscurorum Virorum,' in which the enemies of Reuchlin were ridiculed. When, in 1517, he received the theses propounded by Luther, he exclaimed, "Thanks be to God, at last they have found a man who will give them so much to do that they will be compelled to let my old age end in peace." In 1518 he was appointed professor of Hebrew and Greek at Wittenberg, but sent his nephew Melancthon instead, and William of Bavaria appointed him professor in the University of Ingolstadt. Although suspected of a leaning toward Protestantism, he never left the Roman Catholic Church. Consult: Geiger, 'Johann Reuchlin: sein Leben und seine Werke' (1871); Geiger, 'Johann Reuchlins Briefwechsel' (1875); Horawitz, 'Zur Biographie und Korrespondenz J. Reuchlins' (1877); Holstein, 'J. Reuchlins Komödien' (1888).

REULEAUX — REUSS

Reuleaux, rē-lō, Franz, German mechanical engineer: b. Eschweiler, Prussia, 30 Sept. 1829. He served an apprenticeship at Koblenz, studied at Karlsruhe and for a year was director of a factory in Cologne. In 1856-64 he taught at Zürich and in 1864-96 was engaged in teaching in Berlin, where he was director of the Industrial School from 1868-96. The German exhibit of machinery at the Philadelphia Exhibition in 1876 greatly impressed Reuleaux with the inferiority of German construction and design and he earnestly strove to remedy the fault. He gathered at Berlin a fine collection of kinematic models and wrote: 'Der Konstrukteur' (1860-2); 'Briefe aus Philadelphia' (1877); 'Kurzgefasste Geschichte der Dampfmaschine' (1891); 'Thomassche Rechenmaschine' (1892); etc.

Reuling, roil'ing, George, American ophthalmologist: b. Romrod, Germany, 11 Nov. 1839. He was educated in Berlin and Vienna, served as surgeon in the Prussian army during the war with Austria, and in 1866-7 was assistant surgeon at the Eye Hospital in Wiesbaden. He studied in Paris in 1867-8, came to Baltimore and in 1869 was appointed physician-in-chief to the Eye and Ear Infirmary there. He was professor of ophthalmology at the University of Baltimore, of eye and ear surgery at Washington University, Baltimore, and since 1886 has been professor of eye and ear diseases at the Baltimore Medical College. He is eye and ear surgeon to various hospitals and institutions, has invented an apparatus for eye and ear surgery and written various articles on the subject.

Reumont, roimōnt, Alfred von, German historian: b. Aix-la-Chapelle, Prussia, 15 Aug. 1808; d. Burtscheid, near Aix-la-Chapelle, 27 April 1887. He was educated at Bonn and Heidelberg, and in 1835 entered the Prussian diplomatic service. From 1857-60 he was minister resident at Florence, Modena and Parma successively. Besides several valuable biographies, including 'Michelangelo' (1834); 'Andrea del Sarto' (1835); and 'Benvenuto Cellini' (1887); he wrote: 'Ganganelli, seine Briefe und seine Zeit' (1847); 'Geschichte der Stadt Rom' (1867-70); 'Charakterbilder aus der neueren Geschichte Italiens' (1886); etc.

Réunion, Isle de la, ēl dē lā rā-ū-nē-ōn, or **Isle of Bourbon**, in the Indian Ocean, about 400 miles east of Madagascar, a French insular colony, with an area of about 965 square miles, its length being 45 miles and breadth 33 miles. It was discovered by Mascarenhas, a Portuguese, in 1545, who called it by his own name. The French took possession in 1649, and gave it the name of Bourbon. It was captured by the British in 1810, and restored to France in 1815. The island is of volcanic origin, composed of two enormous volcanic mountains, in one of which the fire is extinct; the other is still in activity. The loftiest summit, Le Piton de Neige, or the Snowy Pike, is about 10,000 feet above the level of the sea. The climate is excessively hot from November to April; the evenings, however, are refreshed by the sea breezes, and the mornings by the land breezes. The capital is Saint Denis, a pretty town; pop. (1899) 32,850. Other urban centres are Saint Pierre, and Saint Benoit, connected by a railway 83 miles long with the chief port, Pointe-des-Galets. The principal articles

of export are coffee, sugar, vanilla, gums, lichens for dyeing, cotton, hides, etc. Sugar is by far the most valuable export; vanilla comes next. Commerce is impeded by the want of good harbors. The population consists of (1901) 173,230 native Africans, Chinese, coolies, Malays, etc., with a French administration and military force of about 1,000.

Réus, rā'oos, Spain, in the province of Tarragona, is an important railway station and a progressive town, with a port at Salou on the Mediterranean, four miles distant. It has excellent schools and model public institutions. Its importance as a commercial centre has increased in a marked manner during the last quarter of a century. Its export houses represent great local industries in the agricultural products of flour, wine, and fruit.

Reusch, roish, Friedrich, German sculptor: b. Siegen, Prussian Westphalia, 5 Sept. 1843. He received lessons at the Berlin Academy, and afterward from Albert Wolff. In 1874 he traveled in Italy for purposes of study, and on his return executed some military statues for Siegen and Bensberg, and a group in marble for the Belle Alliance bridge at Berlin. A lucky inspiration was his 'Demon of Steam.' This spirited and highly original work was modeled in 1880, and subsequently cast in bronze and set up in the Scientific High School at Charlottenburg. He became teacher in the Art Academy of Königsberg (1881), and meanwhile executed numerous busts and statues for public buildings; the monuments of Vessel, the astronomer, and Jacobson, the oculist; the sepulchral monument of Gen. Bronsart von Schellendorf, and the colossal figure of Emperor Wilhelm I. in his coronation robes which stands in front of the palace (1894). Of his imaginative works the most notable are 'Psyche Appeasing Cerberus'; 'Cupid Putting on the Helmet of Mars'; and the 'Triumph of Cupid over Hercules.'

Reuss, rois, Eduard Wilhelm Eugen, German theologian: b. Strasburg, Germany, 18 July 1804; d. there 15 April 1891. He was educated at the University of Strasburg, in Halle and in Paris, was privat-docent at Strasburg and occupied the chair of theology there in 1836-8 and in 1872-88. He was a leader among the liberal Protestant theologians of his day, and an able writer and translator. His works include: 'History of the Sacred Scriptures of the New Testament' (1842); 'History of the Canon of the Sacred Scriptures' (1862); 'The Bible, New Translation, with Commentary' (19 vols., 1877-9); etc.

Reuss, Germany, two central principalities, belonging to an older and a younger line, somewhat intermingled with and lying between Saxony, Bavaria, and the Saxon duchies. Total area of both principalities, 441 square miles, mostly mountainous. The territory of the older line, the principality of Reuss-Greiz, consists of the lordships of Greiz and Burgk, and has an area of 122 square miles. These lordships are separated, one being traversed by the White Elster, while the other lies along both banks of the Saale. The surface is better adapted for pasture than agriculture, rearing great numbers of horned cattle and sheep, but scarcely raising grain sufficient to meet the consumption.

REUSS—REVELATION

The most important crops are potatoes and flax; hops also are partially grown. The weaving of woolen, linen, and cotton fabrics is also among the principal occupations of the people. The capital is Greiz, and the only other town is Zeulenroda. The territories of the younger line, called the principality of Reuss-Gera-Schleiz-Lobenstein-Ebersdorf, have together an area of 319 square miles. These territories are, on the whole, fertile and well wooded, raise sufficient grain to supply the consumption, and possess among their minerals marble, salt, and iron. The capital is Gera, and other towns are Schleiz, Saalburg, Hirschfeld, and Lobenstein. The division into an older and a younger branch dates from 1616. Since 1668 all the princes of both lines have been called Heinrich (Henry). Both lines, as well as the great majority of their subjects, are Protestants. The principality of Reuss-Greiz has a population of about 70,000; Reuss-Schleiz, of 140,000.

Reuss, Switzerland, a tributary of the Aar, rising on the north face of the Saint Gothard, flowing north past Andermatt and Amsteg, between which places its course is through a wild and narrow gorge, spanned by the Devil's Bridge and other wonders of Swiss roadmaking, and entering the south end of the Lake of Lucerne. This it leaves again at its north end, at the town of Lucerne, and, still going nearly due north, reaches the Aar near Windisch (Aargau). Its length is 90 miles.

Reuter, roi'tër, **Fritz**, German dialect poet and story writer: b. Stavenhagen, Mecklenburg-Schwerin, 7 Nov. 1810; d. Eisenach 12 July 1874. He studied law at the universities of Rostock and Jena, and in 1833 was condemned to death at Berlin for his share in a students' democratic society. His sentence was, however, commuted by the king to 30 years' imprisonment. Till 1838 he was a close prisoner in various Prussian fortresses, and after a farther period of confinement in the Mecklenburg fortress of Dömitz was set free in 1840. For 10 years he devoted himself to farming, but in 1850 became a private teacher in the Pomeranian town of Treptow. In 1853 he was made famous by the publication of humorous poems in the Platt-Deutsch dialect, entitled 'Läuschen un Rimels' (new series, 1858). These were followed by 'Polterabendgedichte' (1855) and 'Reis' nah Bellegen' (1855). His later works comprise: 'Kein Hüsung' (1858), a tragical village story in verse; 'Hanne Nüte und de lütte Pudel' (1859); 'Schürr-Murr' (1861), a collection of tales in both Low and High German; and 'Olle Kamellen' (1860-8), his chief prose work, a series of tales in Platt-Deutsch, including 'Ut de Franzosentid' (1860); 'Ut mine Festungstic,' an account of his conviction, and imprisonment (1862); 'Ut mine Strontid,' his masterpiece (1864); 'Dörchlauchting' (1866); and 'De Reis' nah Konstantinopel' (1868); 'Die Drei Langhause' (1878), a satirical play; 'Lustspiele und Polterabendgedichte' (1883); and 'Reuter-Reliquien' (1885). Reuter's stories are lacking in plot, but are marked by clever episodes, skilful character drawing, and a humor, which, despite the difficulty of his medium, was universally appreciated in Germany. An addition of his works appeared in 1863-8, and in 1875 two volumes of 'Nachgelassene Schriften,' with biography, were added by Wilbrandt. Con-

sult the 'Briefe an seinen Vater' (ed. Engel, 1896); Lives by Romer (1895); and Wilbrandt (in 'Geisteshelden' 2d ed. 1896).

Reuter, Paul Julius, **BARON**, German telegraph promoter: b. Cassel, Germany, 21 July 1816; d. Nice, France, 25 Feb. 1899. He settled in Aix-la-Chapelle in 1849, where he first established his system of transmitting news by telegraph to the leading towns on the continent, and in 1858 removed to London, where he undertook to supply the English newspapers with foreign news. His enterprise, known as "Reuter's Agency," occupied a unique field and grew in importance from year to year until it is now in operation in all parts of the world. In 1865 he obtained the permission of the government to lay a cable from England to Cuxhaven, and shortly after to lay one between France and the United States. In 1872 the shah of Persia granted to him the exclusive rights of constructing railways, farming customs, and control of the natural resources of the country, but later exchanged these privileges for that of establishing the bank of Persia. He was created baron by the Duke of Saxe-Coburg-Gotha in 1871.

Reuterdahl, roi'tër-dal, **Henry**, American naval artist: b. Malmö, Sweden, 12 Aug. 1871. He received his academic education at Stockholm, Sweden, and after remaining in this country served as newspaper correspondent during the Spanish-American War. He has contributed to various prominent periodicals in this country and England, and illustrated the 'History of the New American Navy' (1903) by John D. Long (q.v.).

Reutlingen, roi't'ling-ën, Germany, in Württemberg, capital of the circle of the Schwarzwald or Black Forest, on the Echaz, affluent of the Neckar, 20 miles south of Stuttgart. The Church of St. Mary is of great antiquity (13th century), and its tower, 325 feet high, of Gothic type, considered the most beautiful in the kingdom. The environs of the town are most romantic. Its leather and textile industries are important.

Reveillé, rê-väl'yě, or rêv-ě-lě', the signal given in camp and garrison at break of day, by beat of drum or sound of bugle, for the soldiers to rise and begin the duties of the day.

Revel, rêv'ěl, or **Reval**, rêv'äl, Russia, capital of Esthonia, on a small bay of the same name, 238 miles southwest of Saint Petersburg. The ancient part of the city on a rocky eminence is surrounded by Gothic walls and contains the cathedral, castle, governor's residence, high school, and aristocratic quarters; other churches, the town-hall, several fine halls, schools, etc., are located in the lower, or commercial, town. There are two harbors: mercantile and naval. Commerce is comparatively unimportant. Flax, linseed, grains, skins, and potato brandy are exported; salt, wine, fruits, and manufactured and colonial goods imported. Pop. about 68,000.

Revelation, in theology, the communication of truth by God to men; also, the truth so conveyed, and especially in the Scripture. There is a revelation of God's will and his purposes made through man's reason and the voice of conscience: Nature everywhere reveals God's attributes—his power, his goodness, his wisdom, his providence; so, too, the history of

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the tribes of mankind upon the earth affords proofs of divine governance. But the most express revelation of God's purposes toward man is made in the written word, in the record of special divine communications made in time past to holy men "who spake as they were moved by the Holy Spirit"; and this written word is the key to all the other revelations of the divine nature and the divine will. See **INSPIRATION; BIBLE.**

Revelation, Book of. See **APOCALYPSE.**

Revelganj, or Godna, India, in Bengal, near the confluence of the Ganges with the Ghagra, has an active local trade. It is famous as the home of Gautama, the founder of Buddhism, who also taught here. Pop. 14,750.

Revels, Hiram R., American legislator and Methodist clergyman: b. Fayetteville, N. C., 1 Sept. 1822; d. Aberdeen, Miss., 16 Jan. 1901. He was of African descent, was educated at Knox College, Illinois, and ordained to the ministry in 1847. For several years he traveled among the colored people in Ohio, Illinois, Indiana, and Missouri, engaged in preaching and lecturing, and later settled in Baltimore, Ohio, where he acted as a minister and as principal of a high school for colored students. In the Civil War he assisted in the organization of colored regiments and went to the front as chaplain. He settled in Natchez, Miss., after the war, and became an influential citizen. He was a member of the city council of Natchez, elected to the State senate in 1869, and in 1870 was sent to the United States Senate, the first of his race to become a member of that body. He was president of the Alcorn Agricultural and Mechanical University, Rodney, in 1871-83, and at his death was a presiding elder in his church.

Revels, Master of the, an English court officer in former times appointed to superintend the revels or amusements, consisting of dancing, masking, etc., in the courts of princes, the inns of court, and noblemen's houses, during the 12 Christmas holidays.

Revenue, the income of a nation, derived from taxation in various forms. In England the principal source of revenue is the income tax. In the United States the national government derives its revenue chiefly from tariff duties, and internal taxes on alcoholic liquors and tobacco. The revenues of the various States and municipalities are mainly from taxes on land and buildings, and personal property. New York and some other States have an inheritance tax which brings in large returns, so that the New York State government is supported almost without direct taxation. So far as the large majority of citizens are concerned, the forms of taxation in the United States are not directly appreciable. In some countries of Europe revenue is collected by most vexatious methods. In Vienna a small tax is exacted every time the resident of an apartment house goes in or out of the building between 10 P.M. and 6 A.M., the person in charge of the building being the collector, and responsible to the authorities. Methods hardly less annoying are practised in other European cities. The "octroi," a tax on produce of any kind brought into a city from the country districts, is prevalent throughout Europe, and adds to the cost of all kinds of food.

Revenue Cutter, a small armed steam vessel, designed for the prevention of smuggling; so called from the fact that originally the vessel was of the cutter-yacht type. The United State Revenue Cutter Service is a branch of the Treasury Department and its purpose is, principally, to enforce the customs revenue laws. Its immediate supervision resides in a bureau of the department known as the Division of Revenue Cutter Service, which is in charge of a chief and a number of assistants.

Revenue Cutter Service, United States. This service was born in the evening of the 18th century, and therefore on the 4th of August, the current year (1904), it will have been in existence during 114 years of the lifetime of the Republic.

The organization of this service was the conception of our first great secretary of the treasury under the Constitution, Alexander Hamilton, and his recommendations in the premises had the approval of George Washington. In emphasizing its importance Hamilton recommended "giving the officers military or naval rank, which will not only induce fit men to engage, but attach them to their duties with a nicer sense of honor."

The original purpose was to inaugurate a "preventive service," as against illicit trade by sea, and in that sense, to aid the customs service in the collection of the revenue from duties on imposts. The organic act provided for ten small vessels, armed and equipped, and for each a complement of officers and enlisted men, and these formed the nucleus from which has grown the service of to-day.

From the beginning the service was placed upon the same plane as to pay and allowances for its officers and enlisted men, with the officers and soldiers of the army.

Various acts of Congress (1 Oct. 1790, 2 March 1793, 6 March 1796, 1 July 1797) provided for additional and larger vessels, increase of crews, armaments and equipments.

It is interesting to note that this service was the only semblance of a navy possessed by our government from 1790 to 1797, when on 10 July, in the latter year, the first vessel of the then new navy, the 44-gun frigate *United States*, was launched.

In the meantime the duties of the service were such as were required of an armed service, in guarding the coast and commercial interests, and also against piratical incursions. But during those years our relations with France were becoming strained, culminating finally in active hostilities at sea between vessels of the United States and of France. The difficulties with France, generally known as the "Quasi French war," may be said to have been the first war of the young republic with a foreign power. During its continuance (1798 to 1801) several engagements were fought and many captures were made by our vessels.

The revenue cutter service took an active and brilliant part in co-operation with the navy. Thus, while this service was organized as a preventive service to be operated in the interest of commerce and for the protection of the revenue, it had, in these early years, rapidly developed into an armed and equipped military or naval service, offensive and defensive, and

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this character has been well and continuously maintained.

At the breaking out of hostilities with France provision for an armed force upon the sea, to convoy merchantmen and to defend the coast, became indispensable. To accomplish these purposes the President was authorized (Act 1 July 1797) to increase the complements of the several revenue cutters, and to employ them in defensive operations on the coast. Under authority of previous enactments the service had been provided with a number of vessels which, for that time, were of considerable size and able sea-going qualities, so that in this year (1798) there were in commission the following named efficient vessels, aggregating 1,140 tons, carrying 96 guns and 416 men:

	Tons	Guns	Seamen and Marines
Brig Pickering	187	14	70
" Eagle	187	14	70
Schooner General Greene	98	10	34
" Scammel	98	10	34
" Governor Jay	187	14	70
" Virginia	187	14	70
" Diligence	98	10	34
" South Carolina	98	10	34

When it was determined, in 1798, to extend hostile operations against France, to the waters of the West Indies, four fleets, under Commodores Barry, Truxton, Tingey, and Decatur, U. S. N., comprising in all some 20 national vessels, were formed to prey upon French commerce and destroy that nation's privateers, the above named vessels of the revenue cutter service were placed in co-operation with the navy, and sailed with the fleets, and in the summer and fall of 1799 did fine service. It was during this war that the frigate *Constellation*, under Commodore Truxton, captured the French frigates *Insurgent*, 40 guns, and *Vengeance*, 44 guns. During the naval operations against France 22 vessels, privateer and other, under the French flag, were captured, and of these 16 were made prizes by the revenue cutters, unaided, while they assisted in the capture of two others.

The Slave Trade.—Under the provisions of law inhibiting the slave trade, between the United States and foreign countries, the revenue cutter service, in common with the navy, took an active part in its suppression, and in the course of its work captured many slavers and liberated an aggregate of 487 negroes.

The War of 1812.—The well-known causes which led up to the War of 1812 between the United States and Great Britain need not be re-told here. But, for the enforcement of the embargo laws of 1807, Congress by the Act of 6 Jan. 1809, and another enactment of the same date, made provision for additions to the fleet of revenue cutters of 42 vessels. Following the proclamation of the President ordering all British armed vessels to leave the ports of the United States, and laying the first embargo in December 1807, to the close of the War of 1812, which ensued, the service bore an honorable and conspicuous part. Numerous and varied duties in the enforcement of the embargo laws up to the date of their repeal, and subsequently the non-intercourse act, fell

to the revenue cutter service until the declaration of war, 4 June 1812, when the service entered upon an active career, to capture, burn, sink, and destroy the commerce of the enemy in co-operation with the navy. The first prize in that war was the British trading schooner *Patriot*, with a valuable cargo, and was captured by the revenue cutter *Jefferson*, Capt. William Ham, 25 June 1812, just 21 days after the declaration of war.

Following this the cutters *Madison* and *Galatin* made valuable prizes. The British privateer *Dart*, 14 guns, had been for some time cruising and committing depredations on our coast near Newport, R. I. On 4 Oct. 1813, the revenue cutter *Vigilant*, Capt. John Cahoon, having augmented his crew by a draft of some 20 men from the United States frigate *President*, Commodore John Rogers commanding, sailed from Newport in pursuit. Soon after coming up with the enemy he carried him by boarding and conveyed the prize and prisoners to Newport.

One of the most notable actions fought upon the water in the War of 1812 took place in York River, near Chesapeake Bay, on the night of 12 June 1813, between the cutter *Surveyor*, commanded by Capt. William Travis, and forces from the British man-of-war *Narcissus*. The *Surveyor* carried 15 men and was armed with six 12-pounder carronades. The attack was made upon this little vessel by the barges of the British frigate *Narcissus*, which carried to the conflict 50 men, commanded by Lieut. John Crierie. The enemy was discovered by Travis when within 150 yards of the cutter, but the latter's guns could not be brought to bear, so that the defense was necessarily confined to small arms. To each of the *Surveyor*'s crew was given two muskets, with instructions not to fire until the enemy were within pistol range. The engagement was of brief duration, and the enemy by dint of superior force carried the cutter by boarding, with loss of three killed and seven wounded, while of the crew of the *Surveyor* five were wounded and the rest made prisoners of war. On the day following this action the British commander returned Capt. Travis' sword with the following letter:

His Majesty's Ship *Narcissus*,
June 13, 1813.

Sir:—Your gallant and desperate attempt to defend your vessel against more than double your number, on the night of the 12th inst., excited such admiration on the part of your opponents as I have seldom witnessed, and induced me to return you the sword you had so nobly used, in testimony of mine. Our poor fellows have severely suffered, occasioned chiefly, if not solely, by the precautions you had taken to prevent surprise; in short, I am at a loss which to admire most, the previous engagement on board the *Surveyor*, or the determined manner by which her deck was disputed, inch by inch. I am sir, with much respect,

JOHN CRIERIE.

Captain S. Travis, U. S. cutter *Surveyor*.

The lack of space forbids detailed mention of many other incidents to the credit of the service in the War of 1812. But mention is made of the defense of the cutter *Eagle* in Long Island Sound, pursued by the British frigate *Pomone*, 44 guns, and gun brig *Despatch*, 18 guns, and a sloop. The *Eagle* was commanded by Capt. Frederick Lee, R.C.S. On 14 Oct. 1814 the enemy was discovered. Lee, to escape, ran his vessel ashore near Negro Head, Long Island, stripped it of sails and guns, dragged the latter

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onto the bluff, and there the enemy was fought from 9 A.M. until late in the afternoon. When Lee had exhausted his shot and fixed ammunition, he tore up his logbook, made cartridges and returned the enemy's fire. Near nightfall the enemy withdrew and the next day Lee succeeded in floating his vessel and was about getting under way when the enemy returned in force, and this time secured the prize. During this engagement the Eagle's colors were shot away three times, and as often replaced by volunteers from her crew.

During this war the revenue cutter service captured 10 merchantmen, 3 barges, 3 officers and 60 men; 1 privateer mounting 14 guns. The cutters Eagle, Mercury, and Active did duty as scouts and on blockade service.

The cutters Commodore Barry, Surveyor and Eagle were captured by the enemy, but after a hard struggle and most gallant defense.

Neutrality Laws.—The enforcement of the neutrality laws, during the European troubles from 1815 to 1823, engaged much of the attention of the service, but this duty has always been a part of the vigilant work of the service, and is no less true of the earlier years than in the operations of later times.

Nullification, 1832.—During the attempt to nullify the laws relating to the collection of revenue from imposts, by the State of South Carolina, five vessels of the revenue cutter service were ordered to Charleston harbor, with instructions "to take possession of any vessel arriving from a foreign port, and defend her against any attempt to dispossess the customs officers of her custody until all the requirements of the law had been complied with."

The silent influence exerted by the presence of this fleet was a large factor in the solution of the difficulties which menaced peace.

Piracy.—During the early years of the last century, piracy which prevailed along the Gulf coast of our possessions acquired from France and Spain, was suppressed, chiefly by the revenue cutter service. That service waged relentless war upon the corsairs, pursued them into every bay and bayou, broke up their resorts and rendezvous, attacked and dispersed them whenever found. While engaged in this work the cutters Louisiana and Alabama were attacked off the south coast of Florida by the pirate Bravo, commanded by Jean La Farge, a lieutenant of the notorious Jean Lafitte. The Bravo was signally defeated, and carried by boarding in a hand-to-hand struggle. The rendezvous of the pirates on Breton's Island, La., was attacked by the cutters Alabama, Capt. Cartigan, and Louisiana, Capt. Loomis, and the resort broken up. This practically put an end to organized piracy on our Gulf coast, though piratical craft from Mexico, Central America and South America, subsequently made incursions on that coast. The pirate Bolivia with its prizes Antoinette and Isabella were found by the cutter Louisiana, Capt. Jackson, at the South West Pass of the Mississippi River. Jackson attacked at once, captured the Bolivia and liberated the prizes, and carried his prisoners to New Orleans. The Bolivia carried 3 guns and 34 men; the cutter Louisiana 2 guns and 16 men.

Seminole War, 1836-42.—During the Florida war for the suppression of Indian troubles

in that region, the revenue cutters Dallas, Washington, Dexter, Jefferson, Jackson, Madison, Campbell and Van Buren rendered valuable and conspicuous service in Florida waters, co-operating principally with the army. Their services were so important and efficient as to induce from the officers under whose direction they operated the following:

Their prompt and helpful cooperation with the army has called forth the highest commendation from commanding generals, who take occasion to eulogize the services rendered by the cutters.

There were numerous instances of gallant and meritorious services by the officers and men of the revenue cutter service in this war, but the scope of this article forbids more than mention of the fact.

The Mexican War, 1845-7.—The revenue cutter service was represented in this war by the following named cutters: Schooners Forward, Ewing, Van Buren, Wolcott, Woodbury, Morris, and steamers McLane, Legare, Spencer, Bibb and Polk. They took an active part principally in co-operation with the armies under Scott and Taylor.

Some of these vessels, notably the Forward and McLane, served in co-operation with the navy, in the fleet commanded by Commodore Conner. In the squadron of Commodore M. C. Perry, at the capture of Frontera and Tabasco, the Forward took a brilliant part, so much so that the Commodore was moved to say in his official report: "I am gratified to bear witness to the valuable services of the revenue schooner Forward, commanded by Capt. H. B. Nones, and to the skill and gallantry of her officers and men."

The records of the time are replete with incidents of gallant services by the revenue cutter service in the war with Mexico, but the fact can only be stated here.

Paraguay Expedition.—In the naval expedition to Paraguay, in 1858, the purpose of which is matter of history, the steam revenue cutter Harriet Lane, 7 guns, 8 officers and 104 men, served in co-operation with the navy, and rendered valuable services. In acknowledgment of it the Secretary of the Navy wrote:

This department in closing its official connection with Captain Faunce (the commander of the Harriet Lane), is happy to express to you its satisfaction at the prompt, energetic and able manner in which he has conducted his command whilst in its service.

Winter Cruising.—The Act of Congress, approved 22 Dec. 1837, now embodied in Section 1536, Revised Statutes, requires that a suitable number of public vessels shall cruise upon the coast in the severe portion of the winter weather to afford aid to distressed navigators. The work outlined in the law has always been effectively performed by the revenue cutter service, and from 1 December to 1 April of every year the patrol of the coast from West Quoddy Head, Maine, to Cape Fear, N. C., is energetically maintained. As a result of the work many hundreds of lives and many million dollars' worth of property have been saved. Vessels of commerce are frequently fallen in with at sea, with sails blown away, crews frost-bitten, and unable to respond to duty; they are taken in tow and to a harbor; others short of provisions and water are supplied, while others again, found stranded, are floated when possible. In short, everything

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possible is done for the relief and care of the distressed mariner of whatever nationality wherever found, during the hard weather on our storm-driven coast from December to April, and prompt response is always made by the service at the cry of distress at all seasons and all hours.

In the Life-saving Service.—This is an outgrowth of the revenue cutter service, as it formed part of the division of revenue cutter service prior to its organization as a separate service under the act approved 18 June 1878. From its inception in 1848 all stations have been constructed and equipped under the supervision of officers of the revenue cutter service assigned for the purpose. When this service was separated from the revenue cutter service by the act referred to, provision was made for the inspection, drilling, and disciplining of the crews of life-saving stations by officers of the revenue cutter service, and there are at this time (April, 1904) 14 officers of the revenue cutter service on duty in connection with that service. It may fairly be said that the efficiency of the life-saving service in all that relates to its technical features, is due to the energetic and capable officers of the revenue cutter service, who have made the inspections, formulated the drills, practised and drilled the crews of that service. As a matter of course, the able central management of the general superintendent, Sumner I. Kimball, is recognized to the full measure.

In the Civil War, 1861-5.—The service was conspicuous and valuable throughout this period. The limits of this article forbid any detail of duty performed during that trying period. It must therefore suffice to say in the main that from the attempted relief of Sumter in April 1861, to the close of hostilities in 1865, the service was at the front.

The Harriet Lane co-operated with the navy at the capture of the fortifications at Hatteras Inlet; the Forward rendered support and assistance to Gen. Butler at Annapolis, Md.; the Miami covered the landing of troops at Lynn Haven Bay for the recapture of Norfolk; the cutter Naugatuck took part in the attack on Sewell's Point, led the naval fleet up the James River and participated in the bombardment of Drewry's Bluff 15 May 1862; the Nemaha rendered efficient aid to the army and navy on the South Atlantic coast, received on board Gen. Sherman at Fort McAllister, Savannah, Georgia, just from his "march to the sea," and conveyed him to the naval fleet below. The Forward, Brown, Agassiz, Toucy, and Antietam rendered important service in the waters of North Carolina, while the Jackson, Hercules, Reliance, Tiger, and Allen performed excellent service in the Chesapeake, co-operating with the naval forces in the gunboat flotilla in those waters.

In Peace from 1867 to 1898.—The service is always active, always ready for work. Its achievements have been numerous and varied during times of peace, and honorable, often heroic in both peace and war. It blazed the way to and through Alaska, and for many years from the date of the acquisition of that territory in 1867, except for the occasional visit of a naval vessel, was the only service to exercise authority or to display the national emblem in the waters of that coast from Sitka to Bering

Sea, and the Arctic Ocean to Point Barrow. It is on guard in the waters of Alaska from early in May until late in December of every year, rendering aid to shipping, caring for the shipwrecked, and assisting to their homes the unfortunate and the destitute. Its surgeons yearly prescribe for and as far as possible aid the sick, and hardly a year goes by in which more than a thousand cases are not treated or relieved by the medical officers of our cutters in Alaskan waters. In these waters alone the service has rescued and brought home from the Arctic Circle hundreds of shipwrecked whalers, and others, who, but for the timely aid of the service, must have perished.

The memorable cruise of the cutter Bear in the winter of 1897-8, for the relief of whalers in the Arctic Ocean, was performed by officers of the revenue cutter service. The overland expedition from that ship, composed of Lieut. D. H. Jarvis, Lieut. E. P. Bertholf and Surgeon Samuel J. Call, was landed on Nunivak Island, in Bering Sea, in the dead of an Arctic winter, and from that point commenced a wearying march through the snow-covered, ice-bound region that lay between them and their destination, nearly 2,000 miles. Starting on 17 Dec. 1897 they reached their destination on 29 March 1898, taking with them a herd of reindeer as food for the crews of whalers congregated there, and the cheering news that the Bear would arrive with an abundance of food and clothing and to rescue those left and take them to civilization.

On the arrival at Point Barrow Jarvis and his party found terrible conditions confronting, but they set to work with the indomitable energy characteristic of the men, brought order out of chaos, and when the Bear arrived on 29 July following, 97 men were taken on board and conveyed to San Francisco. Of the officers and men who composed the Bear expedition, every one was a volunteer, from the commanding officer, Capt. Francis Tuttle, R.C.S., down.

In the Spanish-American War, 1898.—From the manifold duties in time of peace, the service enters always upon the war stage when duty calls. So in this case, as in all other wars of the nation. Hardly had the tocsin sounded when the revenue steamer McCulloch, bound for San Francisco, was overhauled at Singapore, by cable, directing her to report at Hong Kong to Commodore Dewey, commanding the Asiatic fleet. The ship made a quick run to Hong Kong, joined Dewey, and accompanied him in his Manila campaign, performed fine service, and brought to a waiting world the first news wired from Hong Kong of the victory of Manila Bay. That ship, the McCulloch, remained with Dewey until November following.

In reporting to the Secretary of the Navy, Dewey addressed the following letters:

United States Naval Force on Asiatic Station,
Flagship Olympia,

Cavite, Philippine Islands, June 12, 1898.

The Secretary of the Navy, Washington, D. C.

Sir:

1. I take pleasure in bringing to the attention of the Department the zeal and efficiency of Capt. Daniel B. Hodgson, R.C.S., commanding the McCulloch, while serving in the squadron under my command.

2. The McCulloch steamed from Hong Kong to Manila Bay in the squadron formation and ran the batteries at the entrance with the squadron, and while not placed in the line of battle at the battle of Manila Bay,

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was kept near by and in readiness to assist any vessel that might be disabled.

3. Since joining my command and up to the time of his detachment Captain Hodgson has kept the McCulloch in a high state of efficiency and ready to move at a moment's notice and made her a valuable auxiliary to the squadron.

4. I request that the Department will communicate this report to the honorable Secretary of the Treasury.

I have the honor to be, very respectfully,

GEORGE DEWEY,
Rear-Admiral, United States Navy,
Commanding United States Naval Force on Asiatic Station.

And again, upon the occasion of the detachment of the McCulloch from his command, as follows:

United States Naval Force on Asiatic Station,
Flagship Olympia,
Cavite, Philippine Islands, Nov. 11, 1898.
The Secretary of the Navy:

Sir:—On the occasion of the U. S. revenue cutter McCulloch being detached from my command, I have again the honor to request that you will convey to the Treasury Department my appreciation of her valuable services while attached to the squadron under my command.

2. I have already had the pleasure of bringing this to the attention of the Department, at the time Captain Hodgson was detached, and now beg to state that all duty assigned to the McCulloch while under Captain Hooper was performed with the greatest zeal, efficiency, and judgment.

I have the honor to be, very respectfully,

GEORGE DEWEY,
Rear-Admiral, United States Navy,
Commanding United States Naval Force on Asiatic Station.

At the battle of Cardenas, 11 May, the revenue cutter Hudson, Lieut. Frank H. Newcomb, R.C.S., commanding, sustained the fight against the gunboats and shore batteries of the enemy, side by side with the naval torpedo-boat Winslow, and when Ensign Bagley and half the crew of the latter-named vessel had been killed and her commander wounded, rescued from certain destruction the vessel and the balance of the crew, under the furious fire of the enemy's guns. This gallant action was recognized by the honorable Secretary of the Navy as follows:

Navy Department,
Washington, D. C., June 15, 1898.
The Secretary of the Treasury.

Sir:—I have the honor to acknowledge the receipt of your letter of the 9th instant, and to forward herewith a copy of the report requested. I regret that inadvertently a copy of this letter was not forwarded to you immediately after it was received.

The rescue of the Winslow by the Hudson was so gallantly done, in the face of a most galling fire, that First Lieutenant Frank H. Newcomb, R.C.S., commanding, his officers and men, deserve the warmest commendation. The Winslow was riddled with shell, disabled, helplessly drifting on to the beach into the hands of the enemy, her captain wounded, her only other officer and half of her crew killed, but the Hudson courageously remained by her in the very centre of the hottest fire of the action, although in constant danger of going ashore on account of the shallow water, until finally a line was made fast to the Winslow, and that vessel towed out of range of the enemy's guns.

Very respectfully,

JOHN D. LONG,
Secretary of the Navy.

President McKinley made the work of the McCulloch and Hudson the subject of a special message to Congress, in terms of high commendation and praise, and as a reward of merit in the case of Hodgson of the McCulloch (there being no higher grade in the revenue cutter service to which he could be promoted) that

he be retired from active service on the full pay of his grade, and in recognition of the heroic gallantry noted in the letter of the Secretary of the Navy, the bestowal of a gold medal of honor upon Lieut. Newcomb, of the Hudson, and silver medals of honor to each of his officers, and bronze medals to each of his crew.

It will be noted that the only gold and silver medals bestowed by Congress for services in this war, were those for officers of the revenue cutter service.

There were in co-operation with the navy during this war, 13 revenue cutters carrying 61 guns, 98 officers and 562 enlisted men. Of these eight cutters (43 guns), 58 officers and 339 men were in Rear-Admiral Sampson's fleet and on the Havana blockade. One cutter, 6 guns, 10 officers and 95 men in Dewey's fleet, and 4 cutters, 12 guns, 30 officers and 128 men co-operated with the navy on the Pacific coast. Three other cutters, with 25 officers and 210 men, were ordered into co-operation, but the war closed before they were equipped or could get to the front.

There were in active co-operation with the army and navy together in all 20 cutters, carrying 71 guns, 131 officers and 725 men.

The services performed by the vessels of the revenue cutter service in co-operation with the navy during this war have been acknowledged in proper terms by the officers commanding the fleets with which they served.

Duties and General Features.—The cutter service, under the provisions of Section 2752, Revised Statutes, is purely a technical service, in that no person not trained in the technical profession of the sea can hold a commission in its ranks, and under regulations prescribed in conformity with the law referred to, all officers are required to pass rigid professional examinations for entrance and promotion.

The commissions of its officers are of the same (life) tenure as those of officers of the army, navy, and marine corps. Officers enter this, as they do the services named, in the lowest grades and work their way, by promotion, through long years of service (after examination, mental and physical) to the highest.

The revenue cutter service has always been, since the foundation of the government, constantly regarded and treated as a part of the military force of the country. Its vessels are armed cruisers, officered by men bearing the commissions (under military titles, captains, lieutenants, chief engineers, etc.) of the President, by and with the advice and consent of the Senate, and manned by duly enlisted men; its officers and men are uniformed in accordance with the regulations prescribed by the department; naval discipline and routine prevail on board of all its ships; the officers and crew are required to be proficient in naval drills, and to possess a practical knowledge of the use of arms. The service is required by law not only to aid in the protection of the revenue, but to enforce nearly every statute affecting the maritime interests of the country. By acts of Congress the service is required to aid in the enforcement of the quarantine laws, and in preventing the violation of the neutrality laws; to suppress mutinies on board merchant vessels, and to use the armament of their ships and the force on board when necessary to compel compliance.

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Under the definite provisions of the Act approved 12 April 1902 all officers of this service are invested with military rank, and are placed upon the same level with officers of the army as to pay and allowances, increase of pay for length of service, retirement on account of physical disability, or upon reaching the age of 64 years.

By law (Section 2757, Revised Statutes) the President may, by a simple order, require the service, or any part of it, to co-operate with the navy, when it at once becomes part and parcel of the naval force of the country, and passes from the jurisdiction of the Treasury Department to the control of the Navy Department. The service is, therefore, a part of the regular armed force of the country, identical in character with the naval service, and may at any time, in peace or in war, be made one by executive order.

Organization, Appointments, Promotions.—The number of commissioned officers authorized upon the active list is as follows:

Of the line: 37 captains, 37 first, 37 second and 37 third lieutenants.

Of engineer officers: 1 captain of engineers, who is also the engineer-in-chief, with the rank of captain of the line; 35 chief engineers, with the rank of first lieutenants; 17 first and 18 second assistant engineers, with the rank of second and third lieutenants, respectively, and 1 constructor with the rank of first lieutenant.

There are at this time (April 1904) 45 officers of all grades on the retired list.

Entrance to the service (line) is confined to graduates of the School of Instruction, United States Revenue Cutter Service, to which young men are appointed after physical and mental examinations, as cadets, serving a probationary term of three years. They are, at graduation, commissioned as third lieutenants, and at every promotion thereafter must pass a satisfactory mental and physical examination.

Entrance as engineer officers. The candidate must pass on a high standard, a satisfactory examination, mental and physical, and is then commissioned in the lowest grade, second assistant engineer. Promotions are only gained after rigid examination and record for efficiency.

The enlisted force of the service numbers about 1,250 men.

There are in the fleet 11 cruisers of tonnage from 588 to 985 (gross); 13 cruisers, tonnage from 330 to 416; 13 harbor vessels and launches, and one sailing bark, practice ship for cadets.

Previous to 1889 the chiefs of the service were civilians, and the consulting engineer was employed from the outside. In that year Capt. L. G. Shepard, R.C.S., was assigned as chief, and Chief Engineer J. W. Collins, R.C.S., as engineer-in-chief. Subsequently, by enactment of Congress, the chief of the service must be a captain, while the captain of engineers is assigned as engineer-in-chief. Upon the death of Capt. L. G. Shepard in March 1895 he was succeeded by the writer.

The following table will show the work of nine years (1895 to 1903) in the performance of ordinary duty:

Vessels seized or reported for violation of law	1,598
Fines and penalties incurred by vessels seized.	\$10,721,107

Vessels in distress assisted.....	736
Value of vessels and cargoes.....	\$19,371,505
Persons on board vessels assisted.....	10,349
Lives actually saved	820
Medical aid rendered to persons.....	10,207
Vessels boarded and examined.....	190,360
Miles covered in all of above work.....	3,234,245

C. F. SHOEMAKER,

Captain, U. S. R. C. S., Chief Revenue Cutter Service.

Revere, rê-vêr', Joseph Warren, American military officer: b. Boston, Mass., 17 May 1812; d. Hoboken, N. J., 20 April 1880. He entered the navy as midshipman in 1828, attained the rank of lieutenant in 1841, served in the Mexican War, and in 1850 resigned from the navy. At the outbreak of the Civil War he was appointed colonel of volunteers in the army, and in 1862 was promoted brigadier-general. He commanded a brigade at Fredericksburg and was engaged at Chancellorsville. For his conduct in the latter battle he was censured by his superior officer, tried by court-martial, and dismissed from the service in 1863. The decision was revoked by President Lincoln, and Revere then resigned. He published 'Keel and Saddle' (1872).

Revere (French, RIVOIRE), Paul, American patriot: b. Boston, Mass., 1 Jan. 1735; d. there 10 May 1818. He was trained as a gold- and silver-smith, and was skilful in the engraving of designs for silver plate. In 1756 he participated in the expedition for the capture of Crown Point, upon his return from which he set up as a goldsmith, and also practised copper-plate engraving. Among his prints were a likeness of Samuel Adams, a portrait of King Philip, a view of Castle William, and the Boston Massacre. He also engraved the plates for the earliest paper currency of Massachusetts. In 1774 he was one of the grand jurors who refused to serve in consequence of the act of parliament making supreme court justices independent of the legislature as regards salary. In the autumn of that year he became one of the "thirty North-end mechanics," who patrolled the Boston streets to watch the movements of the British forces. On 14 April 1775 this committee of observation noted preparations in barracks and on board ship on the part of the British. On the evening of the 18th it was seen that troops were marching across the common to the inner bay. Revere forthwith had a preconcerted signal set in a Northend church tower—the honor being claimed for Christ Church and for the church in North Square destroyed by the British—crossed the river, mounted a horse on the Charlestown side, and began his famous "midnight ride." He was none too early, for at 2.30 800 British troops were landed at Lechmere Point and marched on Lexington. Revere became the trusted special messenger of the committee of safety, and after the evacuation of Boston was made successively major and lieutenant-colonel of a regiment of artillery. He took part in the Penobscot expedition in 1779. After the Revolution he resumed as gold- and silver-smith, built a bell- and cannon-foundry, and in 1801 established large copper-rolling works at Canton, Mass. It is said that he was the first in America to smelt copper ore, and to refine and roll copper into sheets and bolts. He

was conspicuously associated with benevolent enterprises. Longfellow's poem, 'The Midnight Ride of Paul Revere,' in which, says Winsor, the author has "paid little attention to exactness of fact," is well known.

Revere, Mass., town in Suffolk County; on the Atlantic coast, and on the Boston & M., the Boston, R. B. and Lynn R.R.'s; five miles northeast of Boston. The place was settled in 1627, and was first named Rumney Marsh. Until 1738 it was a part of Boston. In 1739 it was incorporated as Chelsea, and in 1846 was set off and reincorporated as North Chelsea. In 1871 the name was changed to Revere, in honor of Paul Revere (q.v.). It is a popular residential town and a summer resort. It has a Massachusetts State Bath House, built and maintained by the State; Revere Town Hall, a memorial to Paul Revere; and a Carnegie Library. It has a number of churches and good public schools. The government is by annual town meeting; the administrative officials elected are five, who constitute a board of selectmen. Pop. (1910) 18,219.

Reverberatory Furnace, a furnace in which the material is heated without coming into contact with the fuel. Between the fireplace and the bed on which the material to be heated lies a low partition wall, called a fire-bridge, is placed. The flame passes over this bridge, and plays down against the bed, being reflected or reverberated (whence the name) by a flat arch which surmounts the whole.

Reverend, a title of respect given to ministers of religion—in the United States to the clergymen of all religious denominations, including the Jewish Church: the titles very reverend, right reverend, and most reverend, are given to deans and vicars-general, bishops, and archbishops, respectively. A like usage prevails in England, but strict churchmen of the Establishment refuse to accord the title reverend to the clergymen of the dissenting churches. The Bishop of Lincoln in 1874 refused to allow this title to be inscribed on the tombstone of a Wesleyan minister, and his action was approved by judgment of the Arches court; but that judgment was reversed on appeal to the privy council, when the title was declared to be simply one of courtesy and not confined to clergymen of the Established Church. In Scotland the principals of the universities, if they be clergymen, and the moderator of the general assembly for the time being, are styled very reverend.

Reveries of a Bachelor, or A Book of the Heart, a collection of meditative papers by Donald Grant Mitchell, originally issued under the pseudonym, "Ik Marvel." The first 'Reverie' was published in the 'Southern Literary Messenger' in 1849, and reprinted the following year in 'Harper's New Monthly Magazine.' These papers, full of sentiment, enjoyed a wide popularity at the time of their appearance and still find favor with readers.

Reversion, in biology, the reappearance in an animal or plant of characteristics not of its parents, but of more remote ancestors. This frequently occurs in varieties of domesticated animals or of cultivated plants, which have been produced by artificial breeding, and which suddenly develop traits belonging to the wild stock. The more highly bred and artificial the variety

of animal or plant, the more liable is it to show this occasional reversion. That the tendency is strong and persistent appears from the fact that if the variety is not kept pure by careful breeding, as when a flower escapes from cultivation or a race of domestic animals runs wild, it soon begins to resume the characteristics of, or "revert toward," the wild stock from which it sprang. This reappearance of abnormal characters, as of color, markings, etc., is very likely to occur in the progeny resulting from the crossing of dissimilar races or species, which can be explained only on the supposition that such characters belonged to remote ancestors, perhaps thousands of generations removed. This was illustrated very forcibly by the experiments undertaken at Penycuik, in Wales, by Ewart, in the crossing of zebras with mares, the offspring of which exhibited many peculiarities belonging to neither parent. Under this head, also, will fall the strange phenomenon known to breeders as "throwing back," where a mother animal, which has previously been mated with a sire of another breed or race, will subsequently, when mated with a sire strictly of her own kind, will sometimes produce offspring showing characteristics of the earlier cross. Consult: Darwin, 'Variation of Animals and Plants Under Domestication' (London, 1888); Ewart, 'The Penycuik Experiments' (London, 1899); and the authorities cited under HEREDITY (q.v.).

Reversion, in law, the right to property which remains after some particular estate has ceased which has been granted by the owner. In the United States this is virtually the only meaning of the term in general usage. In England, where the purchase and holding of annuities is common, a reversion means the present right to a payment to be made at some future time, conditional upon certain contingencies, as in the case of an insurance falling to be paid on the attainment of a certain age, or on the death of the assured. The value of a reversion is easily ascertained when the date of its emergence is fixed, and thus a person who has a right to receive a certain sum of money at a given time is enabled to sell this right for its just value.

Reviews. See PERIODICAL LITERATURE.

Réville, rā-vêl, **Albert**, French Protestant theologian: b. Dieppe, France, 4 Nov. 1826. He was educated at Geneva and Strasburg, and was pastor of the Walloon Church at Rotterdam 1851-72. He then removed to Dieppe, where he spent his time in philosophical studies till called in 1880 to the chair of the history of religions in the Collège de France. He was one of the most radical French Protestants of his time, and among his numerous books are: 'Comparative History of Philosophy and Religion' (1859); 'Redemption' (1860); 'Essais de Critique religieuse' (1860); 'Theodore Parker, sa Vie et ses Œuvres' (1865); 'History of the Dogma of the Divinity of Jesus Christ' (1869); 'Introduction to the History of Religions' (1881); 'Histoire des Religions' (1883-9).

Revised Statutes of the United States, a compilation of all the acts of the Congress of the United States: it was first approved by Congress 22 June 1874, thus becoming law: at that time the compilation included all the laws enacted by Congress down to 1 Dec. 1873. The

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second edition of the Revised Statutes comprised the first edition as amended by the 43d and 44th Congresses: supplements have since been approved and published containing later acts of Congress. The act approving the Revised Statutes makes that compilation the authentic and authoritative expression of the laws, without reference to the original acts: but the originals may be quoted to show the true intent of the lawmakers if there is any ambiguity in the compilation.

Revised Version, a revision of the Authorized Version (or King James' Version) of the Bible. The project of the revision originated in the Convocation of Canterbury, 1870, when two companies of biblical scholars of the Established Church, one to revise the Old Testament, the other the New, were appointed, with power "to invite the co-operation of any eminent for scholarship, to whatever nation or religious body they may belong." Afterward, under a resolution of the Convocation, two companies of American biblical scholars were formed, to act with the English companies. The work of revision, which was commenced 30 June 1870, was completed 20 June 1884; the New Testament was published in England and the United States in May 1881, and the Old Testament in May 1885. Many readings and renderings proposed by the American revisers were not approved by the English companies either for adoption into the text or the margin, but were ordered to be recorded at the end of the New Testament or the Old, respectively. But an edition of the whole Bible having the renderings preferred by the American companies and many other renderings since proposed by American scholars has been published in the United States and is known as the American Revision. See BIBLE.

Revival of Letters, a term used to designate the revival of literature after the apparent death blow which it received when the barbarous nations of the North destroyed the Roman empire. It commenced about the beginning of the 11th century, and became more potent in the 14th, 15th, and subsequent centuries.

Revival of Religion, a season of religious awakening out of spiritual torpor or indifference; usually brought about by the fervid exhortations of men deeply impressed with the feeling that the churches, the pastors, and the people have been slumbering while Satan has been gaining possession of the kingdom of Christ on earth. The term, revival of religion, is a modern one, but the thing it signifies is as old as Christianity, as old as Israelitism or as religion itself. The mission of every one of the Hebrew prophets was for the revival of religion; in the Christian Church, revivals, though not called by that name, occurred at intervals from apostolic times; and every sincere and enthusiastic reformer—Saint Peter Damiani, Saint Francis of Assisi, Saint Dominic, in the Middle Ages; the Jesuits, the Redemptorists, and other missionary orders; these were in their time revivalists in fact, though not in name. The Reformation is regarded by Protestants as a great awakening of the Christian consciousness, and the well-spring of all the efforts that have since been made for the renovation of the spiritual life in the Protestant churches. In England, at the beginning of the 17th century the

religion of the Established Church had degenerated into a cold but decent formalism, but a revival of spiritual interest in the common people was brought about through the instrumentality of the Puritans. After the restoration of the monarchy and of the State church there was a period of spiritual sloth and apathy, infidelity, and immorality, till in the 18th century Great Britain was aroused by the fervid preaching of the Wesleys, Whitefield, Rowland Hill, Romaine, Venn, Newton, Cecil, Fletcher, and others, earnest men who were raised up and qualified by the divine spirit for the work which lay before them. (See METHODISTS.) Simultaneously there was a similar great religious movement in the American colonies, especially New England and New York, called at the time the Great Awakening; it seems to have arisen independently of the movement in the parent country; but it was greatly quickened by the missionary labors of John Wesley and George Whitefield during their visits to the colonies. About the same time there was a remarkable revival of religion in various parts of Scotland, especially at Cambuslang and Kilsyth; and out of a similar awakening in Wales arose the Welsh Calvinistic Methodist Church. In 1839 Kilsyth was again the focus of a great revival of religion, which extended to Dundee, Perth, Blairgowrie, Ancrum, Jedburgh, Kelso, and, in the north of Scotland to Ross-shire and Sutherlandshire. In the first half of the 19th century there were many revivals in the United States, notable among which were those under Charles G. Finney (q.v.), who also visited Great Britain and preached to vast crowds in London and other cities; a notable feature of the great revival commenced in 1830 was the camp meetings (q.v.), assemblies of great numbers of people, held in the open air, and addressed by relays of evangelists from morning till night. In 1858 there was a great revival of religion in the United States, which subsequently extended to the British isles and even to the continent of Europe. Its principal centres at first were New York and Philadelphia, whence it spread throughout the States, producing for a time a sort of federation of the evangelical churches for the promotion of the work of spiritual conversion. In nearly every city in the land meetings for prayer were held daily, often in business hours, in churches, in counting houses, in theatres, and other places of public resort; in the one State of New York more than 2,000 cities, towns, or villages had an active part in this revival; throughout the country the interest in the movement was universal; daily reports of the deep religious feeling of the people were received at the principal centres and published in the newspapers. In New York every evangelical church received large accessions to its membership, and a like report was made concerning Boston, Baltimore, Washington, Chicago, Cincinnati, Pittsburgh, and other cities. For nearly two years the meetings for prayer and the labors of the evangelists continued almost unflagging, and for many years noon-hour prayer-meetings continued to be held in the business centres of many of the cities. In the summer of 1859 the movement extended to the north of Ireland, where it was not less fruitful of spiritual good than in America; the people flocked to the services in the open-air

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meetings or assembled in social gatherings for devotional exercises; there was a noticeable diminution of vice and immorality, especially of drunkenness; and judges and magistrates cordially recognized the reality and power of the spiritual work. From Ireland the revival spread to Scotland, and in Glasgow, Edinburgh, Aberdeen, Perth, Dundee, and the other considerable towns, the religious denominations joined in active exertions to bring the neglected poor within the range of evangelistic and educational agencies. It extended to Wales also, where in one year the increase in the membership of the Calvinistic Methodist body alone was 33,724 souls; the gain to the Independent denomination was 30,000, to the Established Church 20,000, and to the Wesleyan body 10,000. Hardly less notable was the revival initiated in Chicago by Dwight Lyman Moody (q.v.) and conducted by him in conjunction with Ira D. Sankey. These two evangelists—a preacher and a singer of the gospel—visited Great Britain in 1873, and for two years in the principal cities of England, Scotland, and Ireland their meetings were attended by multitudes from all ranks of society, and their labors zealously seconded by ministers of all the evangelical churches; thousands of persons professed conversion, and there was a manifest religious awakening. The two evangelists on their return home engaged in revival work of the same kind in the American cities; and they subsequently made two visits to Great Britain, namely, 1883-4 and 1891-2. The Salvation Army (q.v.) and the Volunteers of America (q.v.) are agencies designed to promote a continuous revival of religion, especially among the poor and neglected classes.

Revivals, Religious, seasons at which by extraordinary efforts in preaching, prayer, and hymn-singing, Protestant ministers, especially among the Methodists, seek to arouse the religious feelings and deepen the religious convictions of their hearers. While Protestant revivals were held in England and the United States early in the 18th century, similar movements had taken place previously both in Scotland and Ireland. John Wesley appears to have been the first to develop this method of evangelization into a permanent institution. But in the colony of Massachusetts Jonathan Edwards successfully carried on revivals at Northampton in 1734. George Whitefield was instrumental in extending the movement on his arrival in America (1739), although Gilbert Tennant had previously begun the work in New Jersey. The Great Awakening, as this extended movement was called, occurred between 1740 and 1742, but its quickening results were felt long after and inspired the multiplication of colleges and churches. In the West and South the revival, technically so called, took the form of a camp meeting (q.v.), and these open air gatherings are still made an instrument of evangelization and conversion by the Methodist Church. Out of the camp meeting sprang the Chautauqua Assembly (q.v.), an institution at once educational and religious. Consult: Porter, 'Letters on Religious Revivals' (1850); Starbuck, 'Psychology of Religion' (1900); James, 'Varieties of Religious Experience' (1902).

Revocation of the Edict of Nantes. See **EDICT OF NANTES**.

Revolution, a term commonly used to designate a fundamental change in government, or in the political constitution of a country, effected suddenly and violently, and mainly brought about by internal causes; a revolt against the constituted authority successfully and completely accomplished. In the United States the term Revolution is applied specifically to the American War for Independence, which began in 1775 with the irregular running fight popularly known as the battle of Lexington, and practically ended with the surrender of Lord Cornwallis, at Yorktown, Va., to the combined forces of the French and Americans, 19 Oct. 1781. By this war the colonies succeeded in casting off the English authority and in erecting the government of the United States. The English revolution was that revolution in England by which James II. was driven from the throne in 1688. See **REBELLION**.

In astronomy: (1) The motion of a planet around the sun, or of a satellite around a planet. The point to which it returns is called annual, anomalistic, nodical, sidereal, or tropical, according as it has a relation to the year, the anomaly, the nodes, the stars, or the tropics. (2) In geometry, when one line moves about a straight line, called the axis, in such a manner that every point of the moving line generates a circumference of a circle, whose plane is perpendicular to the axis, that motion is called revolution, and the surface is called the surface of revolution. Every plane through the axis is called a meridian plane, and the section which this plane cuts from the surface is called a meridian curve. Every surface of revolution can be generated by revolving one of its meridian curves about the axis. The revolution of an ellipse round its axis generates an ellipsoid; the revolution of a semicircle round the diameter generates a sphere; such solids are called solids of revolution.

Revolutionary Calendar, a calendar adopted during the French Reign of Terror. It was decreed on 24 Nov. 1793, to commence from the foundation of the French republic, 22 Sept. 1792. The 12 months were Vendémiaire, Brumaire, Frimaire, Nivose, Pluviose, Ventose, Germinal, Floral, Prairial, Messidor, Fervidor or Thermidor, and Fructidor. The first three constituted autumn, the second three winter, the third spring, and the fourth three summer. Napoleon I. restored the old system, 31 Dec. 1805.

Revolutionary Tribunal. A court of extraordinary criminal jurisdiction established by the French Convention, 10 March 1793, for the purpose of trying those accused of plotting "against the liberty, equality, unity, and indivisibility of the Republic, the internal and external safety of the state, or the sovereignty of the people." It received the name Revolutionary Tribunal in October 1793. The court was to consist of a jury and a public prosecutor with two assistants, all named by the Convention, and from its decision there was no appeal. The number of judges rose as high as 80 toward the end of the tribunal's existence. Intended as a means of combating treason at home, the Revolutionary Tribunal speedily became an instrument in the hands of the Committee of Public Safety, whose will it executed under the guise of judicial form. Without any definite pro-

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cedure, with no legal defenders allowed to the accused, and with its acceptance of the vaguest rumors and charges as evidence, the tribunal offered but a mockery of justice and citation before it almost invariably meant death. The reading of the act of accusations, the trial, and the execution of the sentence generally occurred on the same day. The tribunal sent 1,220 victims to the guillotine from its inception till June 1794, when Robespierre (q.v.) caused the infamous law to be enacted accelerating its procedure; from that date to the fall of Robespierre, a period of about 50 days, it condemned 1,376 persons, Robespierre and his followers being among the lot. The tribunal soon after ceased its functions and was formally suppressed 31 May 1795. Its sanguinary work must be regarded as justified to a large extent by its success in saving the country from sedition at home at a time of great national danger. It was but one feature of the organized Terror which saved France from foreign conquest. Consult: Wallon, 'Histoire du Tribunal Révolutionnaire de Paris' (1880-2).

Revolutionary War. See UNITED STATES: AMERICAN REVOLUTION.

Revue Des Deux Mondes ("Review of the Two Worlds"), a noted French bi-monthly publication, which includes among its contributors the highest authorities in French literature and art, and whose criticisms have weight in every civilized land. It was founded by F. Buloz in 1831, and its present conductor is M. Brunetière.

Rewa, rā'wā, India, (1) the capital of a native state of the same name 131 miles southwest of Allahabad, and connected by a branch line with Sutna on the East India Railway. It is enclosed by three wall circuits or ramparts, the outer one massive, and flanked by round towers. Its chief buildings and institutions are the fortified palace of the maharajah, a high school, hospitals, and a model jail. Pop. 24,000. (2) The native state in the Central India Agency, and in the sub-agency of Baghelkand (q.v.), has an area of 12,676 square miles. It is chiefly an elevated table-land, but also comprises portions of the country on both sides of the Kaimor Hills, watered by the Son, a tributary to the Ganges, and flowing northeast. The surface is in part covered with jungle, but on the whole highly cultivated; the condition of the peasantry is, however, much depressed. The ruins of many temples are scattered over the country. The revenue of the maharajah amounts to about \$1,250,000 annually; the armed force consists usually of 4,000 men, though from 10,000 to 12,000 might be mustered. Pop. about 1,700,000.

Rewa Kantha, kân'tū or -tā, India, a political agency under the government of Bombay, containing 61 small states, of which five are tributary to the British government, and most of the remainder to Baroda. The territory included, covering an area of 4,980 square miles, with a pop. (1901) 478,889, lies mainly along the south bank of the lower Nerbudda with patches north of it, and on the western borders of Broach, Baroda, and Ahmadabad.

Reward, in a legal sense, some encouragement which the law holds out for exertions in

bringing certain classes of criminals to justice. The courts may order the sheriff of the county, in which certain offenses have been committed, to pay to persons who have been active in securing the apprehension of offenders charged with murder, or with feloniously shooting, cutting, stabbing, wounding, or poisoning, or with rape, burglary, housebreaking, robbery, arson, or cattle stealing or with being accessory before the fact to any of such offenses, or to receiving any stolen property, a reasonable sum to compensate them for expense, exertion, and loss of time. So by a later statute courts are authorized, in the case of any of the above offenses which they have jurisdiction to try, to order such compensation; but the payment to one person must not exceed \$25. If any one is killed in endeavoring to apprehend a person charged with one of these offenses, the court may order compensation to be made to the family. The amount to be paid in all such cases is subject to regulations which may be made from time to time by the secretary of state. By another statute it is a felony, punishable by penal servitude to the extent of seven years, to corruptly take any reward for helping a person to property stolen or embezzled, unless all due diligence to bring the offenders to trial has been used. In Great Britain an advertisement offering a reward for the return of stolen or lost property, using words purporting that no questions will be asked or inquiry made after the person producing the property, renders the advertiser, printer, and publisher liable to forfeit \$250.

Rewbell, rē-bēl, Jean François, French statesman: b. Colmar 8 Oct. 1747; d. there 23 Nov. 1807. He was a prominent advocate of Colmar, and was elected to the States-General of 1789, where he advocated the principles of the Revolution. He was a member of the Constituent Assembly, where his boldness and legal knowledge made him president in 1791. As a member of the Convention, in 1792 he was outspoken in urging the condemnation of Louis XVI.; but his absence on a mission to the army at Mentz saved him from being numbered among the regicides. He helped suppress the Jacobin Club in 1794, figured as member of the committees of public safety and of general security; and on the adoption of the constitution in 1795 he became one of the five members of the Directory and took in charge the departments of finance, justice, and foreign affairs. In 1796 the Directory elected him its president. He succeeded in defending himself from conviction on charges of peculation, but retired from public life after the *coup d'état* of the 18th Brumaire (9 Nov. 1799) and carried with him a large fortune. Consult Sciout, 'Le Directoire' (1895-7).

Rexford, Eben Eugene, American writer: b. Johnsburg, N. Y., 16 July 1848. He was educated at Lawrence University, Appleton, Wis., and began to write for the press at 14. He has published: 'Brother and Lover,' verse (1886); 'Grandmother's Garden,' verse (1887); 'John Fielding and His Enemy' (1888); 'The Swamp Secret' (1897); 'Flowers: How to Grow Them' (1898); 'Into the Light' (1899); etc. He wrote the popular songs, 'Silver Threads Among the Gold' and 'Only a Pansy Blossom.'

REYES — REYNOLDS

Reyes, Rafael, officially proclaimed as president of Colombia 4 July, and inaugurated 7 Aug. 1904; an explorer, soldier, and statesman. For his discoveries, see *SOUTH AMERICA*, sub-title *Railways and Navigation*. Beside the public service rendered by him when he traveled during several years in unknown parts of the Amazon basin, the facts in his career which deserve special notice are the following: He was commander-in-chief of the Colombian army; was sent to Washington, after Colombia had lost Panamá, to "save whatever he could from the wreck"; and in this patriotic effort he was certainly not altogether unsuccessful, since he gained courage to advocate on his return to Bogotá, the policy indicated in the report which he submitted to his government. He advocated, sensibly, courageously, and magnanimously, a frank acknowledgment by his people of their own blundering which had contributed to the disaster; and he continued to show his people how the natural resources of the vast territory still remaining in their possession could be developed by attracting foreign capital. He succeeded. The very great, imperfectly defined powers of the presidency were entrusted to him, despite the old ultra conservatives' hostility to foreign enterprise, and despite the suicidal scheme of the liberals for permitting Colombia to be absorbed by Venezuela and Ecuador. His success saved Colombia from a future of isolation and stagnation, on the one hand, or, on the other hand, nearly complete loss of identity. President Amador of Panamá and President Reyes exchanged congratulatory messages in August, and the American minister was received at Bogotá in December 1904.

MARRION WILCOX.

Reykjavik, rik'yä'vīk. See REIKIAVIK.

Reynard (rä'nard or rēn'ard) the **Fox**, the name of an epic fable in which the characters are animals, the fox being the hero, and which in various forms was extremely popular during the Middle Ages, and for many years afterward. The latest version of the story, and that which indeed supplanted all the rest, is in the Low German dialect, and was printed at Lübeck in 1498 under the title of 'Reynke de Vos.' The author calls himself Henrik van Alkmer, schoolmaster and tutor to the Duke of Lorraine, but it is believed that this is merely a pseudonym, and that the real author was Hermann Barkhusen, town-clerk of Rostock, and printer there. The 'Reynke de Vos' is in verse, and founded on the oldest Flemish or Dutch redaction of the story in prose. It relates the adventures of the fox (Reynke) at the court of the king of beasts, the lion, and details with great spirit and humor the cunning modes in which the hero contrives to outwit his enemies, and to gain the favor of his credulous sovereign. The poem may be regarded, with Carlyle, as "a parody of human life." There is no personal satire in it, but the allusions to the weak points in the social, religious, and political life of the time are numerous and unmistakable. The fables of Æsop are one of the best known examples of the tendency to represent animals as talking and acting like human beings; but it appears that the beast-fable first took on an epic form among

the German races, especially the Franks, by whom it was carried to the Low Countries and the adjacent parts of France, where it took firm root. In the 10th and 11th centuries the monks of France gave a satirical and didactic turn to the fable, and some Latin poems in which it is so treated are still extant. In these much of the satire is aimed at the pope, the hierarchy, and the powerful Cistercian order. In the mouth of the Franco-Flemish people, however, the fable kept itself clear of such allusions, and soon took on a more purely epic form, aiming its satire at human failings in general. In 1170 the story in this more purely epic form appeared in Germany under the title of 'Isengrimes Nôt,' and somewhat later again in Flemish. In Germany the beast-fable could not maintain its ground side by side with the Swabian court poetry, and was soon given up; while the rhymed 'Reinaert' of the Low Countries, in accordance with an altered taste, was turned into a prose narrative, 'De Hystorie van Reinaert de Vos' (1479). This was soon after translated into English by Caxton, and printed by him at Westminster in 1481. The fable now returned once more to Germany, where the Low German version of Barkhusen took the place of all others. It was translated (1794) into German hexameters by Goethe, who called it the 'Unheilige Weltbibel,' in his 'Reineke Fuchs.' His translation has been turned into English heroic metre by T. J. Arnold (1870). Consult: Froude, 'Short Studies on Great Subjects' (1877-82); Thom's introduction to the Percy Society's edition of 'The History of Reynard the Fox' (1844); Ellis, 'History of Reynard the Fox' (1894); Jacobs, 'Reynard the Fox' (1895); Martin, 'Le roman de Renarte' (Strasbourg-Paris 1882-7); Potvin, 'Le roman du Renard' (Paris 1891).

Reynolds, rēn'olds, **Edwin**, American inventor: b. Mansfield, Conn., 23 March 1831. After obtaining a public school education he entered a machine shop as apprentice in 1847. He was superintendent of shops at Aurora, Ill., 1857-61, and was general superintendent of the Corliss Steam Engine Company, at Providence, R. I., in 1871-7. Later he became president of the Milwaukee Boiler Company, the Daisy Roller Mills Company, and the German American Bank. He invented the Reynolds-Corliss engine; introduced the first triple-expansion engine, the cross-compound hoisting engines for mining work, etc. Since 1877 he has been general superintendent of the Reliance Works at Milwaukee.

Reynolds, John Fulton, American military officer: b. Lancaster, Pa., 20 Sept. 1820; d. Gettysburg 1 July 1863. He was graduated from West Point in 1841, served in the Mexican War as first lieutenant and in 1855 was promoted captain. He was commandant at West Point in 1859-61 and at the outbreak of the Civil War he was appointed lieutenant-colonel of volunteers, receiving his commission as brigadier-general of volunteers in August of that year. He led a brigade in the Seven Days' battle in June 1862 and was brevetted colonel and brigadier-general in the regular army for gallant service. He was placed in command of the First Army Corps in 1863 and promoted major-general of volunteers. He participated in

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the battle of Fredericksburg and commanded on the field of Gettysburg on 1 July until killed by a Confederate sharpshooter.

Reynolds, John Hamilton, English poet: b. Shrewsbury, Shropshire, 9 Sept. 1796; d. Node Hill, Isle of Wight, 15 Nov. 1852. He entered an insurance office, but evidently spent much of his time in writing poetry as in 1814 he published two volumes, 'Safie, an Eastern Tale,' and 'The Eden of Imagination,' the first after the style of Byron, and the latter after that of Wordsworth and Hunt. In 1818 he obtained a lucrative post in a solicitor's office, and later was for a time proprietor of the 'Athenæum.' In 1838 he removed to the Isle of Wight, where he became clerk of a county court. Of his numerous poems the best are published in 'The Garden of Florence, and Other Poems' (1821).

Reynolds, Joseph Jones, American military officer: b. Flemingsburg, Ky., 4 Jan. 1822; d. Washington, D. C., 25 Feb. 1899. He was graduated from West Point in 1843 and after service at Fort Monroe and in Texas was, in 1846, assigned to the 3d Artillery and was on frontier duty at Fort Washita, I. T., in 1855-6. He then resigned to become professor of mechanics and engineering at Washington University, Saint Louis. At the beginning of the Civil War he entered the Federal army as colonel of the 10th Indiana Volunteers, soon becoming major-general of volunteers. He was engaged in the battles of Chickamauga and Chattanooga; later was in command of the defenses of New Orleans from 6 January to 16 June 1864; and of the Mississippi River from its mouth to Memphis, Tenn., from October to December 1864. In 1866 he was mustered out of the volunteer service and promoted colonel in the regular army. He was brevetted brigadier-general in 1867, retiring from active service in June 1877.

Reynolds, Joseph Smith, American soldier and lawyer: b. New Lenox, Ill., 3 Dec. 1829. He was graduated at the University of Chicago in 1866, but had previously served through the Civil War in an Illinois regiment, participating in many battles, and being brevetted colonel and brigadier-general in July 1865. After the war he was admitted to the bar, sat in the Illinois legislature 1866-70, was one of the founders of the Chicago park systems, a member of the Chicago Board of Education 1870-4, and State senator 1872-4. He was senior vice-commander-in-chief of the G. A. R. 1875-6; commander of the Illinois Department of G. A. R. in 1877; and first vice-president of the Society of the Army of the Tennessee in 1879.

Reynolds, Sir Joshua, English portrait painter: b. Plympton, Devonshire, 16 July 1723; d. London 23 Feb. 1792. He was the son of Rev. Samuel Reynolds, master of the grammar school at Plympton St. Mary, Plymouth, who intended him for the medical profession; but Reynolds declared himself for art and went to London in 1741 and studied under Thomas Hudson. This painter was at the head of his profession at a time when there were no very shining lights and from him Reynolds acquired a correctness of drawing and a certain reflection of the style of Van Dyck that gave way subsequently, in great measure, to other influences. He returned to Devonshire after two years and painted portraits for small prices;

went again to London in 1745 and established himself as a painter, but the death of his father the following year recalled him to Plymouth. In 1749 he accompanied young Commodore Keppel, then sent on a mission to the Barbary states, to the Mediterranean and spent more than three years in Italy, mainly at Rome with visits to Florence, Bologna, Parma, Venice, and a short stay at Paris on his return to London. In Italy, he studied the Italian masters, especially in respect to their handling of light and shade. He learned from the Venetians much of their mastery of color, so that when he settled again in London in 1753 his work showed the influence of Correggio primarily with reminiscences of Tintoretto, Veronese, and Titian. In that year he painted a portrait of Commodore Keppel that lifted him at once into fame. This picture, now in the Grosvenor Gallery, is almost a monochrome in gray, with a few faint suggestions of color; but is remarkable for its effects of light and for individuality of portraiture. So popular did the young painter become that in 1755 120 persons sat to him for their portraits. His work, which is of such considerable extent, does not display a uniform excellence, since to produce it all he had to call in the assistance of journeymen. In 1768 he was made president of the Royal Academy upon its establishment; and the next year he delivered his first discourse to the students. His social success was commensurate with his fame as an artist; George III. knighted him and appointed him court painter in succession to Allan Ramsay. He lived on terms of intimacy with Dr. Johnson, Goldsmith, Burke, Gibbon, Garrick, and was the founder of the Literary Club in 1764 where these distinguished men assembled. His body lay in state in the Royal Academy and he was buried in St. Paul's Cathedral.

The mention of his portraits would include all the names famous in the upper world of society and the arts in his day, and there is no higher source for learning of the beauty of English women, the character of English men, and the fashions of taste of the later 18th century. He was graceful in arrangement of figures and accessories, was able in his portraits of men and women to differentiate a masculine vigor and a feminine charm, and in his mastery of color achieved a position, according to Ruskin, as "one of the seven great colorists" of the world. Posterity cannot fully appreciate his power in the latter direction, as he often used impermanent mediums and resorted to a thick impasto, which has cracked with time. His work is amply represented in the National Gallery and the National Portrait Gallery of London and the numerous great collections belonging to noble families. In America his pictures are to be found in fewer numbers in the larger museums and in the possession of private collectors. He published 'Discourses Before the Royal Academy' (1778), and 'Commentary on Du Fresnoy's Art of Painting.' His life was written by Malone (1798), Northcote (1813), Farrington (1819); but among recent biographies consult those by Claude Phillips (1894), Tom Taylor (1865), Sir Walter Armstrong (1900), Gower (1902).

Reynolds, William, American naval officer: b. Lancaster, Pa., 18 Dec. 1815; d. Washington, D. C., 5 Nov. 1879. He entered the

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navy as midshipman in 1831, was commissioned lieutenant in 1841 and in 1851 was retired in consequence of failing health. He was subsequently assigned to duty in Hawaii where he negotiated a reciprocity treaty, and at the outbreak of the Civil War was again assigned to active duty. In 1862 he received command of the Asiatic Station, was promoted captain in 1866, commodore in 1870, and rear-admiral in 1873. He was chief of bureau and acting secretary of the navy in 1873 and again in 1874; and in 1877 was again retired on account of continued ill health.

Rezonville, rê-zôn-vêl, **Battle of**. See GRAVELLOTTE, and FRANCO-GERMAN WAR.

Rhabdocœlida, răb-dô-sê'li-dă, an order of *Turbellaria* which is characterized by the simple, unbranched, and rod-shaped alimentary canal. Some forms are very minute and often mistaken for *Infusoria*. Transverse fission is common in certain forms, and the power of regenerating lost parts is very great. A few genera have acquired a strictly parasitic habit, and a few also are marine and land forms, but most are inhabitants of fresh water. In many species two sorts of eggs are produced: summer eggs which are thin-shelled and are retained in the uterus until hatched, and winter eggs, which possess heavy brown shells, and, though produced in the fall, do not hatch out until spring. All *Rhabdocœlida* undergo a simple direct development.

Rhab'domancy. See DIVINATION; DIVINING ROD.

Rhadamanthus, răd-a-măn'thūs, according to Greek legend, a son of Zeus and Europa, and brother of Minos, king of Crete. According to another tradition Rhadamanthus laid the foundation of the Cretan code of laws, which his brother Minos completed. From fear of his brother he is said to have fled to Ocaleia in Bœotia, where he married Alcmena. In the belief of the Greeks a spirit in the lower world continued the business of life, hence Rhadamanthus, after his death, was made a judge in the kingdom of Pluto, or the Islands of Blessed, on account of the justice of his life, and had for his associates Æacus and Minos. The name suggests an Egyptian origin of the myth.

Rhadames, ră-dă'mēs. See GADAMES.

Rhætia, rê'shî-ă, a Roman province comprising the regions of Rhætia proper and Vindelicia and extending from the land of the Helvetii in Gaul to Noricum on the west, and from Gallia Cisalpina to the Danube. It included within its bounds what are now the Grisons and the Tyrol, the southern districts of Bavaria and Württemberg and the region of the Italian Alps, and contained the sources of the Rhine (Rhenus), the Inn (Alnus), and the Adige (Athesis), with many other rivers of northern Italy. The principal towns were Tridentum (Trent) in Rhætia proper and Augusta Vindelicorum (Augsburg) in Vindelicia. The original inhabitants of the country were considered by most ancient writers to be Etruscans who had been driven out of Italy by the invasion of the Gauls and who under their leader Rhetus took possession of the mountainous country. Modern research has tended to confirm the view of the ancients. The Rhætians were a brave and warlike people and their

frequent inroads into northern Italy led to retaliation on the part of the Romans. After a bitter struggle they were subdued in 15 B.C. by Drusus and Tiberius, stepsons of Augustus Cæsar. With Vindelicia, which was conquered at this time, the southern region was united to form the province of Rhætia. Diocletian divided the province into two, giving to the southern part the name of Rhætia Prima, while Vindelicia was known as Rhætia Secunda. After passing into the power of the Ostrogoths in the 5th century the region was overrun by the Boiarii who settled in the eastern part, the Alemanni who occupied the west, and the Longobards who established themselves in the south.

Rhamnaceæ, răm-nă'sê-ê, an order of trees and shrubs. The species, of which about 500 have been described and classified in about 40 genera, are mostly natives of temperate and tropical countries, in which they are widely distributed, especially in the northern hemisphere. They are frequently spiny, have usually simple leaves and inconspicuous, small, greenish blossoms which are followed either by dry fruits which break at maturity into three parts, or by fleshy ones which do not split open when ripe. In several species the fruit is edible as in the jujube (*Zizyphus jujuba*). The red fleshy pear-flavored peduncles of *Hovenia dulcis* are eaten in Japan and China, where the plant is native. Some are important ornamental plants; for instance buckthorn (*Rhamnus*), and New Jersey tea (*Ceanothus*). Various species of the former genus are valued for the yellow and green dyes they yield and *R. frangula* for its charcoal which is used in making gunpowder.

Rham'nocathar'tin, in chemistry, the uncrystallizable principle of buckthorn berries, distinct from rhamnin, the crystallizable glucoside in the berry. It is an amorphous, yellowish, brittle mass, soluble in all proportions in water and alcohol, but insoluble in ether. It has a bitter and very repulsive taste, and, when heated, melts to a yellowish-brown oil, gives off inflammable vapors, and leaves combustible charcoal. Ferric chloride colors it dark green, and, when heated with nitric acid, it yields a large quantity of picric acid.

Rhampsinitus, răm-sî-nî'tūs, a Græcised form of the Egyptian name Rameses, Rameses III., the first king of the 20th dynasty and the builder of the pavilion of Medinet Habu at Thebes. Brugsch makes Rhampsinitos a Greek form of *Ramessu pa nuter* ("Rameses the God"); Maspero, *Ramsis-si-nit* ("Rameses, son of Neith"); by Diodorus he was called Remphis (Rempsis), from which comes the name Rameses by which Pliny called the monarch. Of him Herodotus (II., 121 *et seq.*) relates a story substantially the same as one of the most widespread folk-tales of the Aryan world. The king acquired an enormous treasure, and to secure it built a treasury of stone. The architect left one stone loose, so nicely adjusted as to be unnoticed, yet, capable of being taken out and replaced without difficulty. Before death he entrusts the secret to his two sons, who from time to time plunder the king's treasure at their will, until at length the elder is caught in a snare set by the king. According to his desire, the younger brother cuts off and carries away his head, so that he may remain unknown. The king now orders the headless body to be ex-



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RHAPSODISTS — RHEA

posed unburied, protected by a guard of soldiers, but the younger brother lades an ass with skins of wine, allows some of it to run out, and is relieved in his distress by the soldiers, to whom in gratitude he gives his wine so freely that they all sink into a drunken sleep. Thereupon he shaves the right half of all their beards, and carries his brother's body to his mother. The king next sends his daughter to find out the clever thief. She promises her love to those who reveal to her the most extraordinary things that have ever happened to them, and when the young man in his turn relates the strange passages of his life she seizes him; but he cunningly slips his brother's dead hand into hers, and so escapes. The king is so much struck with wonder and admiration that he promises the clever thief his daughter in marriage, since he surpassed all mankind in knowledge; for, while the Egyptians surpassed all the world, he surpassed the Egyptians.

The wealth of Rameses III. is said to have been equal to 400,000 talents, or \$387,500,000, an incredible sum for those ages. It is represented on the walls of the palace treasury in the Medinet Habu as consisting of the precious metals and of wonderful jewels.

Herodotus gives the generally accepted story of the supposed thefts from the treasury, but his chronology and historical facts have been proven to be too inaccurate to be relied upon.

Rhap'sodists, a name given the wandering minstrels among the ancient Greeks, who sang the poems of Homer and those of other poets. They were for a long time held in high esteem, until the poems were committed to writing, and through the medium of manuscript copies became pretty generally known, when the rhapsodists soon lost their importance. Each ballad or recitation was termed a rhapsody, and thence it was applied to the separate books of the 'Iliad' and 'Odyssey.'

Rhat'any, or **Rattany**, shrub-like plants (*Krameria ixiina* and *K. triandra*) of the order *Polygalaceæ*. They are natives of the Peruvian and Bolivian Andes, and are confined mainly to the table-lands of high altitudes. The roots are used extensively for coloring Portuguese wines and for mixing with charcoal or orris-root to be used as a dentifrice; and are an important article of export from Peruvian ports.

Rhazes, **rā'zēs** (ABU BEKR MAHĀMMED IBN ZAKHARIYA AR-RAZI), Arabic physician: b. Rai or Raz (ancient Rhagæ), near Teheran, probably 923 A.D. He acquired great philological and philosophical knowledge, but studied chiefly music. Eventually he became expert in the medical science of his day, and was made director of the Bagdad hospital. There is a story that, when aged, he became blind, and refused to have an operation performed upon his eyes, because the surgeon about to undertake it could not tell how many membranes the eye contained. When it was urged that the operation might nevertheless succeed, he still refused, saying that he had seen so much of the world he was weary of it. The best known of the books that pass under his name is 'Al-Havi,' but its authenticity is questioned. His treatise on the smallpox and measles is the oldest account in existence of those two diseases. It has been translated several times into Greek and Latin, and into English from the Arabic

text by Greenhill (1847). His 'Ketab Al-Mansuri' is a complete system of medicine drawn from Arabic and Greek sources.

Rhé, **île de**, **êl de** **râ**. See **Ré**, **Île de**.

Rhea, **rē'a**, an ancient Cretan earth-goddess, daughter of Uranus and Gæa, wife of her brother the Titan Cronus, and by him mother of the Olympian deities Zeus, Hades, Poseidon, Hera, Hestia, Demeter. She was early identified with the Asiatic nature-goddess Cybele, the Great Mother, who was worshipped on mountains in Mysia, Lydia, and Phrygia. Her Cretan *Curetes* corresponded to the Phrygian *Corybantes*, many of whom mutilated themselves like Attis in the frenzy of their orgies. Rhea was supposed at first to make her home in the towering hills of Asia Minor. It was her delight to tame the ferocious beasts found in these wildernesses, as well as to protect the fair towns lying in their valleys. Thus she became known as Mater Turrata, and was represented as wearing a crown, turreted like a wall. Rhea's supposed love for the Phrygian shepherd, Attis, gave much color to her worship. In Pessinus, in Phrygia, there was a cave under Mount Dindymon, where was a large stone supposed to be the heaven-sent image of the goddess, as well as the tomb of Attis. This was the centre of her worship, and here the first temple to Rhea is said to have been erected by King Midas. From this centre the worship spread to the neighboring towns and provinces, finally reaching Athens. The worship of Rhea continued long after the decadence of Phrygian civilization. Its introduction into Rome, during the second Punic war, was the result of a prophecy of the Sibylline Fates which told that her image brought to Rome would expel a common foe. The stone in the cave at Pessinus was therefore placed in the Temple of Victory in the capital city, a holiday being proclaimed to celebrate the event.

Rhea, the generic and usual book-name of the South American ostriches or nandus, which, although true ratite birds and occupying the place of ostriches in the American avifauna, yet differ so greatly from the African species that ornithologists universally rank them as a distinct family (*Rheideæ*) or even order (*Rheæ*). Conforming to the general type of the ostriches, the rheas differ in having three toes with large claws, the head and neck fully feathered, the flowing plumes absent from the wings, and especially the tail, the ischiatic instead of the pubic bones forming the pelvic symphysis and the palatal structure peculiar in several respects. Three species of *Rhea* have been described; *R. americana*, found throughout the greater part of South America; *R. macrorhyncha*, which is confined to northeast Brazil and is distinguished by its darker color and longer bill; and *R. darwini*, of southern Argentina, which is smaller and has tarsi covered with small scales instead of scutes as have the others. The newly hatched young of the latter are said to have the legs feathered to the toes. Rheas are known to the natives as nandus or emas (the latter a corruption of emu introduced by the Portuguese), and live in small parties on the pampas and dry plains, where they associate with wild horses, deer, and guanacos. In general habits they closely resemble the ostriches (q.v.), but usually run with the wings lowered instead of

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elevated. They are said to be able to swim across wide rivers. Because of the well-developed syrinx, which is absent in the ostriches, the male rheas have a loud, resonant call, especially heard during the mating season, when they also fight viciously. They are polygamous and the male incubates the score or more of eggs deposited by several females in one nest. They are omnivorous. Although lacking the precious plumes of the ostrich the feathers of the rhea have a commercial value in the manufacture of feather dusters. Many thousands are killed by shooting or with the bolos, or are run down with hounds or horses and clubbed to death. In many places they are threatened with extinction; but, although they breed readily in confinement, no efforts to raise rheas on a commercial scale appear to have been made. Consult: Darwin, 'Voyage of the Beagle' (New York, 1889); Mosenthal and Harting, 'Ostriches and Ostrich Farming' (London, 1877).

Rhea, or China Grass. See **RAMIE**.

Rhea Letter, The, in American history, a famous political episode of the time of the Monroe administration. On 6 Jan. 1818, Andrew Jackson, then army department commander in the Southwest, wrote to President Monroe regarding the Seminole troubles in Florida and advising the prompt seizure of East Florida, which he declared could be done "without implicating the government." He offered to accomplish the seizure himself within 60 days, if it should be indicated to him that it were desirable. John Rhea, a congressman from Tennessee, was the secret channel through which he hoped Monroe's assent might be signified. It was not. In 1831, during Jackson's administration, in the height of his quarrel with Calhoun, which turned in part upon the Seminole affair, Rhea wrote to Monroe, hoping to elicit from him something that would implicate him as approving Jackson's plan. Monroe, on his death-bed in New York, denounced Rhea's insinuations as utterly false.

Rhead, Louis John, American artist: b. Etruria, Staffordshire, England, 1860. He was educated at the Art Training School, London, and in 1883 came to the United States to act as art manager for D. Appleton & Company. He has exhibited work in both oil and water colors in various American and European galleries and won a medal in Boston in 1895 for his artistic posters. He has illustrated many books, among them being: 'Pilgrim's Progress'; 'Idylls of the King'; 'Robinson Crusoe' (1900); Dr. Hillis' 'Psalms of David' (1900); etc.

Rheam, Henry Meynell, English artist: b. Birkenhead 13 Jan. 1859. He was educated in Germany and took up the study of painting at Heatherleys in 1884 and continued it in Paris under Bongerueau and Tony Robert Fleury. In 1890 he became allied with the Newlyn group of painters. His 'Spells' was purchased in 1893 for the Walker Art Gallery by the Liverpool Corporation.

Rhees, res, Rush, American Baptist clergyman and educator: b. Chicago, Ill., 8 Feb. 1860. He was graduated from Amherst College in 1883, and from the Hartford Theological Seminary in 1889. He was pastor of the Middle Street Baptist Church, Portsmouth, N. H., 1889-92, and professor of biblical New Testa-

ment interpretation (1892-1900) in the Newton Theological Institution, Newton Centre, Mass. He was elected president of the University of Rochester, Rochester, in July 1900. He has published 'The Life of Jesus of Nazareth: a Study' (1900).

Rhees, William Jones, American bibliographer: b. Philadelphia 13 March 1830; d. Washington, D. C., 13 March 1907. He was graduated from the Central High School of that city in 1847 and was in charge of the social statistics of the 7th census (1850-2). In 1852 he became chief clerk of the Smithsonian Institution of whose publications he had general charge. He wrote 'Manual of Public Libraries, etc., in the United States and British Provinces in North America'; 'The Smithsonian Institution'; 'James Smithson and his Bequest.'

Rheims, rēmz, Fr. rāns (Reims), France, in the department of Maine, 100 miles northeast of Paris. Strong forts crown the adjacent vine-clad hills. Its industries are considerable, embracing, besides champagne, the manufacture of textiles, dyeworks, breweries, distilleries, etc. It is also an important market for raw wool. The town was early imbued with a religious character owing to many solemn and historical rites celebrated in its great cathedral. Here the kings of France were successively crowned for many generations, and Clovis (438-533) was baptized within its walls. The façade of the cathedral is a mediæval masterpiece. A wealth of tapestry, sculpture, and paintings (Titian, Tintoretto, and Poussin) beautify the interior, and innumerable statues of artistic grace adorn the exterior. The rose-window and portal are of rare magnificence. The archiepiscopal palace, town-house and museum are notable buildings. Pop. about 110,000.

Rheingold, rin'gölt, Das ('The Rhine-Gold'), a music drama by Richard Wagner, prelude to 'Der Ring des Nibelungen.' It consists of four scenes, the first disclosing the depths of the Rhine, where on a high cliff rests the Rheingold guarded by the three Rhine-daughters. The possession of a ring wrought from this gold would give supreme power over the world; but in order to work the charm whereby the ring must be made, the one essaying it must have forsworn love. Alberich, the Nibelung, comes to the depths of the Rhine, and gains possession of the gold through the carelessness of its guardians. Scene II. reveals Wotan and Fricka before the castle of Valhalla, built for Wotan by the two giants Fasolt and Fafner. Straightway the two appear and claim as the promised reward of their labors Wotan's daughter Freia, the goddess of youth. Loge, the demigod of fire, who had persuaded Wotan into the contract with the giants with the assurance that he would provide some way of evading the payment, now appears, and reports that in his search over the world he had found that nothing in water, on earth, or in air would ever give up the love of woman; but that the Rhine-daughters had told him of Alberich, the present ruler of Nibelheim, who had forsworn the love of women and made himself a ring by power of which he had amassed great treasure. The giants, to whom Alberich of old was an enemy, offer to give up Freia in exchange for the Nibelung's treasure. Thereupon (Scene III.) Wotan and Loge, together

with the two giants and Freia, descend to Nibelheim, make Alberich a prisoner, rob him of his treasure, his Tarnhelm, or cap of darkness, which Mime, his brother, has made for him, and also the ring, which Wotan places upon his own finger. The helpless Alberich curses the ring and prays that it may bring death and destruction upon every one into whose hands it comes. Freia is finally ransomed by the gold, the Tarnhelm, and also the ring, which Erda advises Wotan to add on account of the curse placed upon it. No sooner do the giants possess their treasure than they quarrel over its division, and Fafner strikes Fasolt dead, thus realizing the first curse of the ring. After a mighty storm summoned up by Donner (Scene IV.), the gods cross a rainbow bridge leading up to Valhalla, Wotan, plunged in thought, leading the way, while the voices of the Rhine-maidens are heard lamenting the loss of their gold.

This work was performed first (without authorization) at Munich in 1869; then at Baireuth in 1876; for the first time in America, at New York, in 1889. It contains remarkable passages of instrumentation, especially in the introduction, which consists of 136 measures running throughout in the chord of E-flat major.

Rhenish (rĕn'ish) **Architecture.** See GERMAN, *Architecture*.

Rhenish Confederation. See CONFEDERATION OF THE RHINE.

Rhenish Prussia. See RHINE, PROVINCE OF THE.

Rheostat, in electricity, an instrument invented by Wheatstone for measuring electrical resistances. Two rollers, one non-conducting, and the other of brass, are geared together, so that when either is turned by means of a handle a fine copper wire will be uncoiled from one roller as it is wound upon the other. Two binding-screws, one of them in contact with the brass cylinder and the other with the end of the wire on the non-conducting cylinder, connect the apparatus with the wires of the battery. To use the rheostat, the resistance to be measured is put in circuit with a constant battery and a galvanometer, and the indication of the galvanometer is noted; the resistance is then removed from the circuit, and the rheostat is put in its place, and the handle turned till the galvanometer gives the same reading as before; the resistance of the rheostat is now the same as the resistance which was to be measured, and it is measured by the number of coils of copper wire on the insulating roller.

Rheotropism, that tendency in plants which leads their roots, when immersed in running water, to curve in accordance with the current. Positive rheotropism causes the roots to curve up stream; and negative rheotropism produces the opposite curvature.

Rhesus or **Bengal Monkey**, a common Indian macaque (*Macacus rhesus*). It is a strong species with powerful limbs, but without the ruff or beard found in some allied species. The body attains a length of about two feet, and the tail is of medium length. Brown is the prevailing color, but the bare face and the callosities are flesh-colored or red. The rhesus monkey is very intelligent and mischievous, and the young ones can be easily tamed. In several

parts of India the Hindus protect this species, for which they have a great veneration.

Rhetoric, the art of correct speaking and writing, of using language not only correct as to grammar, but best adapted to convey the effect desired by the speaker or writer. The term "rhetoric" is, however, usually applied to spoken discourse, which may either be a simple statement of fact or theory to one or more persons, or an oration intended to make a profound impression on a vast multitude of hearers and readers. An oration may be powerful and at the same time ungrammatical; in such case it is outside the bounds of rhetoric, in the strict meaning of the word. He who cultivates rhetoric must keep within the recognized rules of language. He must be grammatical as well as logical. Rhetoric includes, along with correct expression, the acquirement of a clear and pleasing style, and attractiveness in presenting a subject. It is, in brief, the art which aims to bring to highest perfection the attribute of speech, which distinguishes man from all other animals, and which is the chief instrument of human progress and achievement. In ancient and modern times, rhetoric has therefore been regarded as one of the noblest studies. Among the Greeks Aristotle and Longinus were the great masters of rhetoric, and Aristotle's 'Art of Rhetoric' still remains the ablest analysis ever written of the mental and ethical characteristics of oratory. Among the Romans Cicero held the palm as an authority on this subject. It was not emphasized in the Middle Ages, but in modern times it has again arisen to importance, and every leading institution of learning has its chair of rhetoric. In no country in the world is the art of rhetoric more generally cultivated than in the United States, owing to the freedom of speech and of the press, and to the fact that effective oratory is almost certain to command public preferment. The student of rhetoric should consult Blair's 'Lectures on Rhetoric,' Campbell's 'Philosophy of Rhetoric,' and other standard works on the art, and he may study also with the best results the orations of Webster, Clay, and other great speakers, the messages and addresses of Lincoln, Washington's 'Farewell Address,' and other well known examples of pure and vigorous English.

Rhett, rĕt, **Robert Barnwell**, American politician: b. Beaufort, S. C., 24 Dec. 1800; d. Saint James' Parish, La., 14 Sept. 1876. He was the son of James Smith, but in 1837 adopted the name of Rhett, a prominent colonial ancestor. He studied law, was elected to the legislature in 1826, and in 1832 was elected attorney-general of the State. He was one of the leaders of the Nullification movement and a more strenuous advocate of States' right than even Calhoun. In 1837-49 he sat in Congress and in 1850 was elected to succeed Calhoun in the Senate. He stoutly upheld slavery, opposed all compromises, and in 1851-2 he urged the secession of South Carolina, whether accompanied by other States or not. After the elections of 1852 Rhett resigned from the Senate and retired to his plantation. He later edited the Charleston 'Mercury' in which he advocated his extreme views, and in 1860 he again came into prominence as a member of the South Carolina Convention and was one of the committee which

wrote the address giving reasons for secession. He was a delegate to the provisional congress at Montgomery, Ala., in 1861, and later an active member of the Confederate Congress. He removed to Louisiana after the war.

Rhett, Thomas Grimke, American military officer: b. South Carolina about 1825; d. Baltimore, Md., 28 July 1878. He was graduated from West Point in 1845, served in the Mexican War, was brevetted captain for conduct at Puebla in 1847 and in 1858 received rank as major. In 1861 he resigned his commission in the United States army and was commissioned major-general by the governor of South Carolina. He was chief of staff to Gen. Johnston until 1862 and was then assigned to the trans-Mississippi department. He served as colonel of ordnance in the Egyptian army in 1870-3 and then resigned.

Rheumatism, a constitutional disease characterized by inflammation of the connective-tissue structures of the body, especially of the joints and muscles, and attended by localized pain. It is usually recurrent. Three forms are recognized: (1) acute rheumatism (acute articular rheumatism, acute inflammatory rheumatism, rheumatic fever); (2) chronic rheumatism; (3) muscular rheumatism or myalgia.

Acute rheumatism is marked by high fever, inflammation and swelling of one or more of the larger joints, intense pain, increased by movement, profuse sweating, scanty high-colored urine, and a tendency to inflammation of the endocardium (endocarditis) and of the pericardium (pericarditis). In many cases there is apparently a hereditary tendency; in others, sudden checking of perspiration in a cold and damp atmosphere may cause the disease. Conditions which lower vitality, such as chronic alcoholism, nervous debility, or poverty associated with exposure and insufficient food, are predisposing causes. More males than females have acute rheumatism, probably because of more hardship and exposure. It is quite common among farmers, longshoremen, coachmen, stokers, motormen, sailors, scrub-women, etc. It most frequently occurs between the ages of 15 and 30, is rare before the 10th year and after the 50th. An injury to a joint, or excessive muscular work, may be the initial cause. The disease is rare in the tropics, common in the temperate zones; in the United States it is most frequent in the early spring and late fall; and it is often endemic and sometimes epidemic.

The specific cause or origin of rheumatism is not known. That it is always due to an arthritic diathesis, inherited or acquired, is a theory not generally accepted in this country. The infection theory of Hueter, though accepted by many, is not generally adopted. As to the chemical theory, that the disease is due to an excess of lactic or uric acid in the blood, some believe that the acids are due to bacterial activity; others, that all the phenomena of rheumatism cannot be produced by one chemical substance. The nervous theory, not fully recognized, assumes that the joint-lesions are trophic, owing to disturbances of the nervous system, from the action of cold on nerve-centres, etc. The morbid anatomy shows characteristic disorders of the joints—synovial membrane swollen and hyperæmic; serous infiltration of liga-

mentous and other tissues; joint-fluid turbid with albumen, fibrin and leucocytes (pus and blood rarely present); sometimes ecchymoses on cutaneous and serous surfaces. In the blood the red corpuscles are reduced more than one half; the hæmoglobin is much less than normal; but fibrin and leucocytes are largely increased. The heart is affected in very many cases, most frequently the left side (rheumatism of the heart), the edges of contact of the mitral valves being swollen and covered with fibrinous masses; less frequently, the aortic valve; rarely, the pulmonary or tricuspid. Contraction and distortion of the affected valves may result. Ulceration is rare. Simple fibrinous or sero-fibrinous pericarditis is common; myocarditis seldom occurs. The attack may begin with headache, indigestion, aching, chilliness, slight tonsillitis or pharyngitis, but usually comes with a chill, followed soon by high fever (may be 103° or 104° F.), swelling, tenderness, heat, and shiny appearance of one or more joints (knees most often, then wrists and fingers, ankles, etc.), a coated tongue, foul breath, a soft pulse of 100 to 110, thirst, constipation, and by profuse sour sweat. If not treated, the disease lasts from two to three weeks. There is always a tendency to recurrence, complications, and migration from one joint to another. The mind is clear, except when the fever is very high. Coma, which is rare, is due either to high fever or nephritis.

So-called cerebral rheumatism is due to a toxic congestion. Sometimes urticaria and spots of ecchymosis appear upon the skin, and in children small nodules, firm but movable, are attached to tendons and fasciæ, and are found over the spine, scapula, and inflamed joints.

Follicular tonsillitis is considered by some to be due to rheumatism. But the most serious complications of acute rheumatism are endocarditis and pericarditis. Other complications are chorea, conjunctivitis, pleurisy, bronchitis, peritonitis, orchitis, etc.

There is a sub-acute rheumatism, very common, with mild symptoms and slow recovery. It may follow an acute attack or be sub-acute from the outset, and may pass into the chronic form. Temperature is seldom above 102° F. The so-called acute rheumatism of children is usually sub-acute; the joint-symptoms may be so slight as to be readily overlooked, but there is more liability to cardiac inflammation than in adults. Children perspire less, but are liable to have chorea, tonsillitis, and cutaneous manifestations.

Acute rheumatism is to be distinguished from arthritis following scarlet fever and other acute diseases; from acute osteomyelitis, scurvy (in children), gout, arthritis deformans, and gonorrhœal rheumatism.

Severe cases may recover within a week; and mild cases last several weeks. The joints are not left with fibrinous adhesions unless chronic rheumatism supervenes. Death is rare, and when it occurs it results from high fever, pneumonia, pleurisy, or myocarditis. Relapses are quite common. Treatment requires many details. Among preventive measures are care against exposure to cold and damp, especially when overheated; freedom from muscular strain; the wearing of woolen underclothing in winter, and of linen-mesh in summer; abstinence from

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sweets and malt liquors; very moderate eating of animal food; sponging with cool water, followed by friction; outdoor exercise; and the keeping of the bowels open with Carlsbad water or Rochelle salt. During the attack place the patient between blankets on a comfortable mattress; have him use a bed-pan; carefully dispose the inflamed part in a comfortable position. While the disease is severe give light food, no meat, sweets, or malt liquors; allay fever with cool spongings, and tincture of aconite; quiet the patient with Dover's powder or codeine; locally apply methyl salicylate, oil of wintergreen, or equal parts of guaiacol and glycerin; and keep the part warm with cotton batting, oil-silk, etc. Medicinally, salicin, salol, or salicylate of soda and bicarbonate of potassa or soda, or the citrate of potassa seem to be of most avail.

Chronic rheumatism is a form of chronic joint-inflammation, attended by moderate pain, and by changes in the joints resulting in their deformity. It begins insidiously, or follows attacks of acute or sub-acute rheumatism, and is rare before the 40th year. The predisposing causes are poor hygienic conditions, debility, malnutrition, cold and damp, and occupations which involve the repeated and long-continued use of certain joints, as in the cases of seamstresses and tailors. A moderate thickening and some distortion appear in affected joints (fingers and knees especially) which may be bilateral. The changes are mainly in the fibrous tissues, though sometimes there is synovial injection and effusion. Erosion of cartilages is seen only in prolonged cases. Endocarditis, pericarditis, and pleurisy are rare.

The symptoms slowly develop; general health may be good; pain occurs when joints are red and swollen, and may be severe at night. Joints swell from time to time, and some persons readily predict an attack. The muscles about the joints after a time atrophy and the affected joints are deformed by deflection due to adhesions. Slight fever may accompany attacks. The diagnosis excludes gout and arthritis deformans (qq.v.).

In treatment medicine is of uncertain value. Iron, Vichy water, iodide of potassium, and Carlsbad salts or phosphate of soda may be used. More relief is to be obtained from douching and sweating of the joints, massage, protection against cold and damp and injuries to the joints, an ample diet (no sweets, and no alcoholic stimulant except whiskey), a dry equable climate, and residence at one of the spas.

Muscular rheumatism, or *myalgia* is a painful affection of various voluntary muscles and of the fasciæ and periosteum to which they are attached. It is most common in youth and young adults and among those exposed to cold and damp when overheated, and those who overuse certain muscles. Heredity, goutiness, and lithæmia are predisposing causes. The disease is never fatal, whether it is neuralgic in character or is an inflammation of muscular tissue (myositis) is not determined. The symptoms include local pain and tenderness, increased by contraction or movement of the affected muscle; usually the pain is an intense dull ache. There is seldom any heat, swelling, or redness. Occasionally the muscle cramps and is most comfortable if semiflexed. Sometimes there is fever. In torticollis or stiff-neck (unilateral) some of the muscles

of the neck are involved. The patient dreads to move the head, and moves the body instead. In pleurodynia one side is affected (generally the intercostal muscles, but sometimes in the serratus and pectoralis), usually the left. Pain is increased by movements, coughing, or sneezing.

Lumbago, a muscular rheumatism affecting the muscles of the lumbar region and their tendinous attachments, is bilateral, quite frequent, and is often caused by strain of the muscles of the loins. An attack often begins suddenly with an excruciating pain when the sufferer is attempting to rise from a sitting posture, or to change his position in bed. If the loin-muscles are kept rigid the patient may be able to move about. Treatment calls for rest of affected muscles (best in bed), the application of heat and anodyne liniments, ironing the loins with a hot flation over a few thicknesses of flannel or thick wrapping paper, or galvanism.

Muscular rheumatism is distinguished from neuralgia by localized pain, increased by voluntary movements, and by the absence of tender spots. Recovery usually occurs in a few days, except in debilitated persons, those with rheumatic tendencies, or subjects of chronic alcoholism.

Preventive treatment requires freedom from damp and cold, and from muscular strain, sponging and friction, vegetable diet, and warm underclothes. Massage and a Turkish bath may prevent an attack. For local treatment rest, heat, turpentine stupes and anodyne liniment are of use. Medicine is of little value. In pleurodynia, strapping the chest, or the use of a wide flannel binder, is often of much service.

Rheumatism-root. See TWIN-LEAF.

Rheydt, rit, Germany, a town of Prussia, in the government of Düsseldorf, 16 miles west of Düsseldorf, important on account of its industries, which embrace silk and satin goods, cottons, and mixed fabrics, foundries and machine-shops, printing and dyeing works, breweries, distilleries, etc.

Rhigas, ri'gas, **Constantine**, Greek patriot: b. Velestino (the ancient Pheræ) about 1753; d. Belgrade, Servia, 1798. He wrote not only in Greek but also in French, and was a poet and a proficient in music. He formed the bold plan of freeing Greece from the Ottoman Porte by means of the secret association of the Heterææ, and succeeded even in bringing powerful Turks into his conspiracy. From Vienna he kept up a secret correspondence with the most important confederates in Greece and in other parts of Europe. At the same time he composed in his native language a number of patriotic songs, calculated to inflame the imagination of the Greek youth and embitter them against the Mussulmans. Having been arrested in Trieste he was with several other prisoners conducted to Vienna. Rhigas and three others of those arrested were sent back in chains to Belgrade in May 1798, and put to death by the Turkish authorities. During the Greek war of independence, which ultimately led to the emancipation of their country from the Turkish yoke, his songs were in the mouth of everyone. The most celebrated of them are his translation and adaptation of the 'Marseillaise.' Consult: Edmonds, 'Rhigas Pheraios, the Protomartyr of Greek Independence' (1890).

RHINE

Rhine, *rin*, a river of Germany, and until the Franco-German war of 1870-1, the boundary for a part of its length between France and Germany. It is one of the most picturesque rivers in the world, and its natural beauty is heightened by the historic and legendary traditions with which its name is associated. Its direct course is 460 miles long and its indirect course about 800 miles; the area of its basin is about 86,600 square miles. It is formed in the Swiss canton Grisons by three main streams called the Vorder, Mittel, and Hinter Rhein, or the Upper, Middle, and Lower Rhine. The Vorder Rhein rises in the small Toma Lake (7,690 feet high), lying to the northeast of the St. Gothard, and is augmented by two streams which unite with it near Chiamut (5,380 feet). The Mittel Rhein issues from a small lake west of the Lukmanierberg, traverses the Medelserthal, and joins the Vorder Rhein at Disentis, from which point the united stream is called Vorder Rhein. It takes an easterly direction, and at Reichenau unites with the Hinter Rhein, which issues from the Rheinwald Glacier, in the Adula group, and has a course of about 70 miles through the Rheinwaldthal before reaching Reichenau. Here the stream takes the name of Rhine, has a width of 130 to 140 feet, and admits of floating. The Rhine first becomes properly navigable at Coire after receiving the Plessur. It now turns north, and shortly after being augmented by the Landquart quits the Grisons, forms the boundary between the canton of St. Gall on the left and Liechtenstein and Vorarlberg on the right, receiving the Ill from the latter, and enters the Bodensee or Lake of Constance, continued by the Untersee. On issuing from the Untersee it flows west, separating Switzerland from the grand-duchy of Baden, and continues its course to Schaffhausen and Basel, receiving, as it proceeds, on the left the Goldach, Thur, Thöss, Glatt, and Aar, and on the right the Wutach and Alb, mountain streams of the Black Forest. At Schaffhausen the river forms perhaps the grandest waterfalls in Europe. At Basel it again begins to flow north, when it separates the German territory of Alsace from Baden, forms the boundary between the latter and the Bavarian palatinate, flows thereafter through the grand-duchy of Hesse, forms the boundary first between it and Nassau, and then between Nassau and the Prussian Rhenish province, till it wholly enters the latter at Coblenz. Below Emmerich it enters the Dutch province of Gelderland, and shortly after divides into two branches, a south and a north. The south, called the Waal (anciently Vahalís), carries off two thirds of its water, and joins the Maas or Meuse at Woudrichem. The north branch, after making several windings in its course to Arnhem, but still retaining the name of Rhine (Rijn), divides at Westervoort, before reaching Arnhem, into two branches. Of these the right proceeds as the New Yssel, in the bed of the canal which Drusus dug to connect the Rhine with the Old Yssel, till it reaches Doesburg, where the New and Old Yssel unite to pour their accumulated waters into the Zuyder Zee. The left arm proceeds, under the name of Rhine, in a course nearly parallel to the Waal, passing Wageningen and Rhenen to Wiikby-Durstede, where it again bifurcates, sending a very feeble branch, under the name of the

Crooked Rhine, to Utrecht, where, by the canal of Vaart, it communicates with the much larger branch, called the Leck, and flowing past Vianen and Schoonhoven unites with the Maas above Grimpén-op-de-Lek. The Crooked Rhine becomes little better than a ditch; on leaving Utrecht it proceeds toward Leyden, and at the beginning of the 19th century was lost in the sand beyond Katwijk-aan-den-Rijn. At an earlier period it had here found an outlet into the ocean; and in more recent times, after surmounting many difficulties, the lost water of the Rhine has been collected in a canal, and by the aid of three sluices the outlet has again been established. The breadth of the Rhine and the character of its channel differ much at different parts of its long course. Its breadth at Basel is 750 feet; between Strasburg and Spirens from 1,000 to 1,200 feet; at Mainz 1,500 to 1,700 feet; and at Schenkenschanz, where it enters the Netherlands, 2,150 feet. Its depth varies from 5 to 28 feet, and at Düsseldorf amounts even to 50 feet. The Rhine abounds with fish, including salmon and salmon-trout, but more especially sturgeon, lampreys, pike, and carp. Wild fowl also abound on its banks and countless islands. Some gold is contained among the sands brought down into it from the mountains of Switzerland and of the Black Forest.

The navigation of the Rhine is very important, particularly for west Germany. The navigation is rendered dangerous by waterfalls, more especially those of Schaffhausen, of Zurzach (near the mouth of the Wutach), of Laufenburg, and of Rheinfelden; it is also rendered dangerous by the Bingerloch, near Bingen, where the stream becomes suddenly narrowed and confined between lofty precipices, and by similar causes, though in a less degree, at Bacharach, St. Goar, and at Unkel.

The Rhine is distinguished alike by the beauty of its scenery and the rich fields and vineyards which clothe its banks. Hence no river in Germany, more especially since the introduction of steam-vessels, attracts so many tourists. From Basel to Mainz it flows through a wide valley, bounded on the left by the Vosges, and on the right by the Black Forest and the mountains along the Bergstrasse. From Mainz the mountain ridges approach the stream at first only on the right bank, where they form the Rheingau; but at Bingen they begin to hem in the left bank also, and continue from thence to Königswinter to present a succession of lofty mountain summits, bold precipices, and wild romantic views. Pleasant towns and villages lie nestled at the foot of lofty hills; above them on all sides rise rocky steep slopes clothed with vines, and every now and then the castles and fastnesses of feudal times are seen frowning from precipices apparently inaccessible. At times the chain of ridges on either side opens out, and allows the eye to wander into romantic valleys, along which tributaries of less or greater magnitude keep dashing down or gradually winding to the parent stream. On the river itself much additional variety and beauty are given to the scenery by the constant recurrence of picturesque and verdant islands.

Scarcely a river in the world is of importance to more people than the Rhine. Since long before Cæsar's day this great stream has been the scene of stirring events in the world's drama.

RHINE — RHINOCEROS

Vercingetorix, Charlemagne, Tilly, Wallenstein, Frederick the Great, Napoleon Bonaparte, Bismarck, and Moltke, these are some of the illustrious names in the long roll of warriors who strove along its banks for command of this great highway. Famous in song and story, lined with great cities and ruined castles of robber barons, it is the Mecca of tourists at all seasons of the year. Up one side and down the other, or by river from Cologne to Mainz, every mile has its beauties and its legends. Between Darmstadt and Heidelberg the Taunus Mountains shut in its basin on one side, the Odenwald, scene of the Siegfried saga of Wagner's Nibelungen operas, on the other. An ideal region for the man fond of walking tours, for the villages are so close together that no spot along its banks is more than an hour's walk from a village. Cyclists and automobilists find good roads, generally military highways, all the way from Holland to Basel and the Lake of Constance.

Rhine, Confederation of. See CONFEDERATION OF THE RHINE.

Rhine, Province of the, or Rhenish Prussia (Ger. *Rheinland*), the westernmost province of Prussia, touching west and north, Luxemburg, Belgium, and Holland; greatest length from north to south about 200 miles, greatest breadth about 90; area, 10,423 square miles. It is divided into five governments or districts, Coblenz, Treves, Cologne, Aachen (Aix-la-Chapelle), and Düsseldorf. The city of Coblenz is the official capital of the province, but Cologne is the town of most importance. The southern portion of the province is hilly, being traversed by the ranges of the Eiffel, Hochwald, etc. It is watered by the Rhine, the Moselle, and some affluents of the Meuse. A large proportion of the surface is in forest. Besides the usual cereal crops, tobacco, hops, flax, rape, hemp, and beet-root are raised; fruit culture and the vine culture are also carefully attended to. Cattle are extensively reared. It is the most important mineral district in Germany, abounding in coal, iron, lead, zinc, etc. It is likewise an active manufacturing district, there being numerous iron works and machine shops, textile factories, breweries, distilleries, etc. Pop. about 5,759,000, the majority Catholics.

Rhine Wines. See WINES.

Rhineland, rīn'lān'dér, Wis., city, county-seat of Oneida County; on the Wisconsin River, and on the Saint Paul & S. S. M., and the Chicago & N. R.R.'s; about 100 miles northwest of Green Bay. The Pelican Rapids in the Wisconsin at this place furnish extensive water-power. It is in a lumbering region, and its chief manufacturing establishments are lumber mills, which have about 500 employees; paper mills, 175 employees; refrigerator works, 75; boat building works, 30; iron works, 20; and minor industries, 250 employees. There are seven churches, Saint Mary's Hospital, seven public schools, one parish school, and a Carnegie Public Library. The two banks have a combined capital of \$100,000. The government is vested in a mayor and 12 aldermen. Pop. (1890) 2,658; (1900) 4,998. In 1910 the population was 5,637.

Rhini'tis. See NOSE AND THROAT.

Rhinoceros, a massive hoofed mammal of the family *Rhinocerotidae*, characterized prominently by its nasal horns, the species of which are now confined to South Africa and southeastern Asia, although in past ages of world-wide distribution. These animals are all of large size and ungainly form, and the very thick skin is usually thrown into folds of more or less definite kind, and as a rule is very sparsely haired. The limbs are stout and comparatively short, and terminate in round feet with three toes on each foot, each toe encased in a hoof. The skull is of pyramidal form, with a confluent orbit and temporal fossa, and the nasal bones are very prominently developed, and support one or more "horns," which grow one behind the other. The muzzle is extended by a more or less elongated pointed and prehensile upper lip; the incisors and canines are diminished but functional in the African species, and entirely wanting in adults of the Asiatic species. The cheek-teeth are massive and their crowns exhibit complexly folded ridges, varying much with the species. The horn of the rhinoceros is of epidermic origin, based upon thickened "bosses" of the underlying bone, but really formed of fibres of horn practically bristles, agglutinated as they grow. When two horns are developed, the hinder one is borne by the



Indian Rhinoceros (*Rh. indicus*).

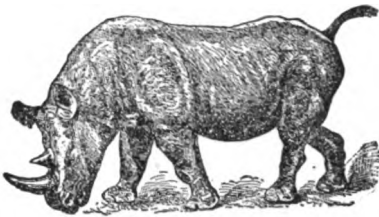
frontal bones, and is situated in the middle line behind the front horn. The front horn is generally much larger than the hinder one, the latter, when larger, possessing a different shape from the front structure. They serve many useful purposes in savage economy, but are of little service in civilized arts, although formerly the horn was considered to have medicinal and even magical virtues, especially in the detection of poisoned wine.

Although subdivided by some zoologists, the rhinoceroses may properly be regarded as forming only a single genus, *Rhinoceros*, with five existing species, and some extinct species, to which must be added several genera known only by fossil remains.

The most familiar species is the typical one-horned or Indian rhinoceros (*Rh. indicus*), which, like all the Asiatic species, has the skin thrown into very definite folds, corresponding to the regions of the body. The horn of this species is black, very thick, from one to (rarely) two feet long, and rises from the tip of the nose. The upper lip is very large, and overhangs the lower; it is furnished with strong muscles, and is employed by the animal somewhat as the elephant uses his trunk. The skin is naked, rough, extremely thick, and of a purplish brown hue. About the neck it is gathered into large folds; a fold also extends between

RHINOCEROS

the shoulders and fore-legs, and another from the hinder part of the back to the thighs. It is naturally soft and easily penetrated by a rifle-ball or hunting knife, but when suitably dried is exceedingly hard and polishable. The tail is slender, flat at the end, and furnished at the sides with very stiff black hairs. This animal was well known to the ancients when it ranged over most of the peninsula of India, and was introduced into the games of the circus by Pompey. From the time of the fall of the Roman Empire, however, it was lost sight of so completely, that, prior to the 16th century, naturalists were of opinion that it had never existed, or, if so, that it was extinct. When the Portuguese, however, opened the way to India, these animals again became known, and many were introduced into Europe, a historic one, sent by an Indian potentate to the king of Portugal in 1513, stood as model for a well-known drawing by A. Dürer. This species is now much restricted in range, and not to be found outside of the plain of Assam, where it confines itself to the marshy grass-jungles, where, like its relative, the tapir, it is fond of wallowing in the mud. Though possessed of great strength, and a match for either the tiger or the elephant, it is quiet and inoffensive unless provoked. The female



African Rhinoceros (*Rh. bicornis*).

produces one at a birth. The growth of the young is very gradual, as, at the age of two years, it scarcely attains half the height of the adult, which is usually about five feet at the shoulder; such a specimen will measure about 9½ feet from the snout to the root of the tail. The sight of this rhinoceros is by no means acute, but, on the contrary, its senses of smelling and hearing are very keen. Its chief food is canes and shrubs. The flesh somewhat resembles pork in taste, though of a stronger flavor and coarser grain. It can be successfully hunted only by the aid of elephants, and is now protected by law against extermination. It lives well in captivity, and specimens may be seen in many zoological gardens, but it does not breed in captivity.

The Javanese or Sondaic rhinoceros (*Rh. sondaicus*) is distinguished from the Indian species by smaller size, shorter horn, and differences in the disposition and tessellated appearance of the skin-folds, which is also somewhat more hairy. It occurs in the Sunderbunds of India, in Bengal, and in the Malayan Islands. The Sumatran rhinoceros (*Rh. sumatrensis*) is well distinguished by having two horns, the rear one like a big knob, and in being clothed with a comparatively thick coat of hairs. Its range is similar to the Sondaic species, but it also extends to Borneo. A variety living in the Assamese swamps has been called the hairy-

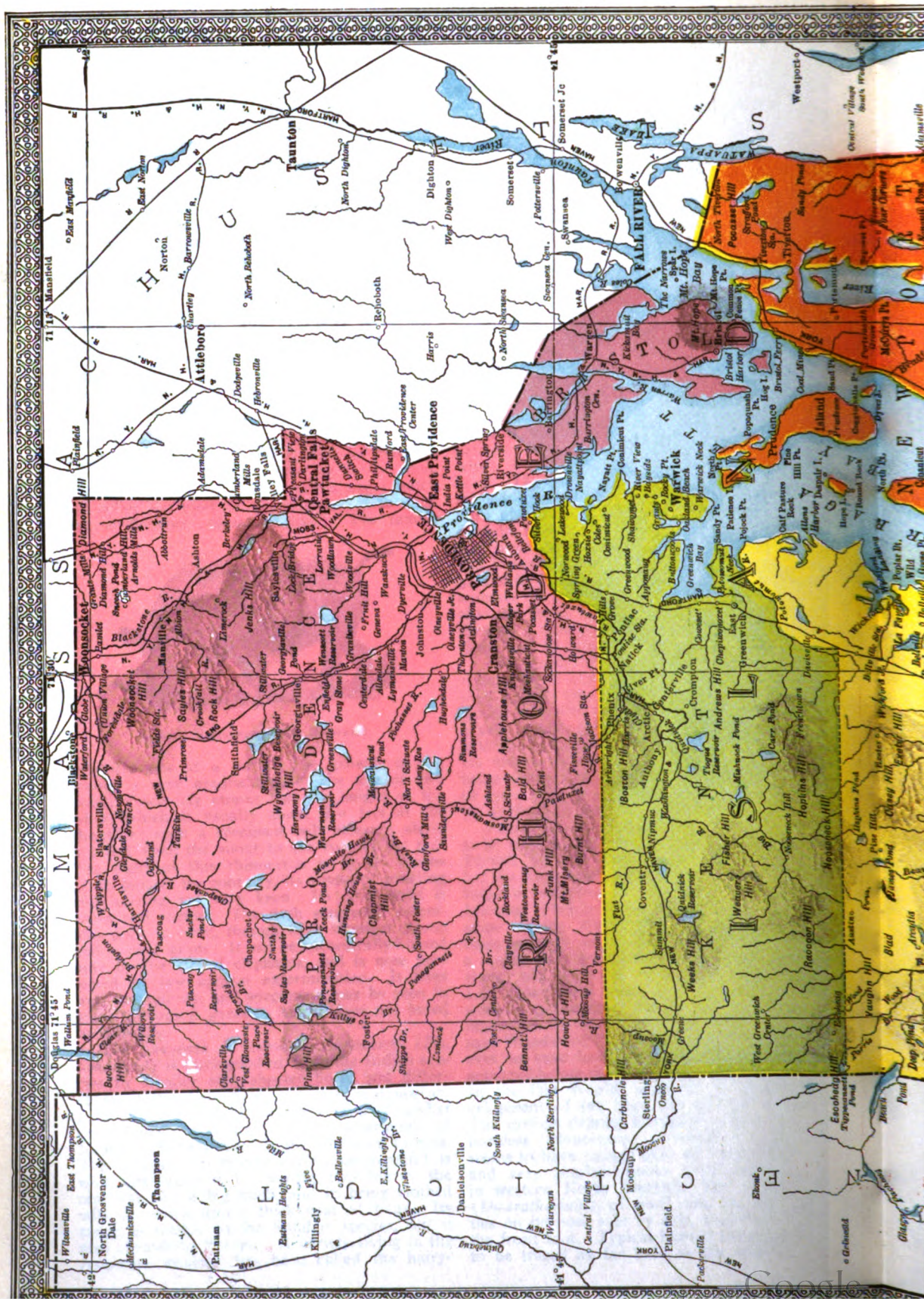
eared rhinoceros (*Rh. lasiotis*). The upper lip of this species forms a short proboscis and it gets its food mainly by browsing shrubs.

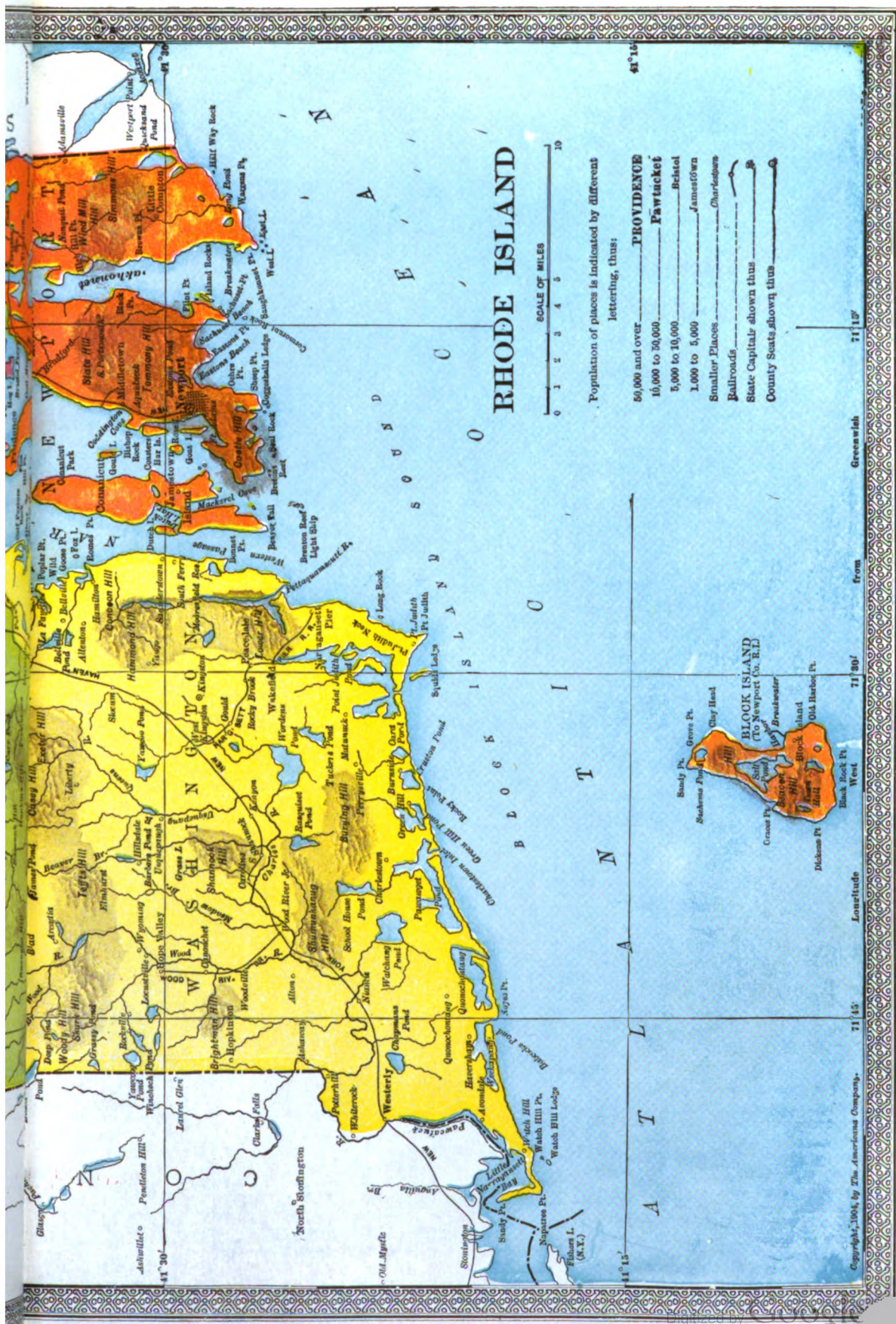
The African rhinoceroses are two, both differing from the Asiatic group in dentition, and in the absence of the armor-like plates and folds in the hide, which is hairless and lead-colored. Considerable variation exists, so that half a dozen or more distinct forms have been named, but all seem referable to two species,—the ordinary widespread African rhinoceros (*Rh. bicornis*), and the square-mouthed (*Rh. simus*). The former is to be found, except where killed off by civilization, throughout all southern and eastern Africa outside of the equatorial forests, and it does not show the fondness for swamps which characterizes the Asiatic congeners. Its front horn is broad and raised as on a base, sharp-pointed, and curved slightly backward, while the hinder horn is usually shorter and more conical. The head is rounded. This animal appears to be of ferocious disposition, and is quick and active, and greatly feared by the natives. The food consists largely of roots, which it digs out of the earth by aid of its horn. The side of the horn is thus frequently rubbed by contact with the earth. This long horn may attain a length of 3 to 3½ feet, and straight ramrods are made from it. The lip is somewhat pointed and prehensile, and the animal browses much of the time. It is justly regarded by hunters as one of the most dangerous animals in the world to meet, and it often charges from ambush, or dashes frantically through a camp, so that many persons have lost their lives by it outside of chosen encounters.

The square-mouthed, white, or Burchell's rhinoceros is a northerly, and now almost extinct species (*Rh. simus*), which dwelt in East Africa and was distinguished by its huge size, a male standing 6½ feet high at the shoulder, with the front horn 50 or more inches in length. Its muzzle is short and square, the upper lip being short and its food consisting altogether of grass. Its general habits otherwise are similar to those of the other species.

Fossil Rhinoceroses.—These animals begin to be recognizable toward the end of the Eocene Period, both in Europe and North America; but the first form of which much definite knowledge is possessed is *Hyracodon* of the Lower Miocene (White River beds) of the eastern slope of the Rocky Mountains. This was a comparatively small, slightly built animal with a longer neck and limbs than later rhinoceroses show, and no trace of a horn is perceptible. Like other early forms it was tridactyl, but in some a rudimentary fourth toe (the 5th) remains on the fore foot. "In North America," says Woodward, "a normal horn does not appear ever to have been acquired, and the race disappeared before the close of the Pliocene. . . . In the Old World, however, the gradual development of the horn can be clearly traced." The earliest definite European remains are of a hornless rhinoceros (*Aceratherium*), which seems to have ranged over all Europe and Asia, and very similar species lived simultaneously in western North America. One of the latter (*Diccratherium*), of small size, had two callosities on its nose side by side, and four digits in the front foot. Typical horned rhinoceroses are to be traced as far back as the middle of the







RHINOCEROS-BIRD — RHODE ISLAND

Miocene, and they had all the essential features of the modern ones, and no one-horned fossils have been found outside of the Indo-Malayan region. The upper Pliocene species bore horns so large that the septum between the nostrils was ossified for their support. This feature is noticeable in the species (*Rh. leptorhinus*) common in England in the time immediately subsequent to the Ice Age; and reaches its maximum in the great woolly rhinoceros (*Rh. tichorhinus*), whose bones are found in the cave deposits and river gravels from Great Britain to China, and whose mummified remains have been taken, like those of the mammoth, from the ice-cliffs of arctic Siberia. It had immense horns and was covered with dense woolly hair. Another huge, but aberrant rhinoceros (named *Elasmotherium*) roamed over Russia and northern Asia at the same Pleistocene period, which was sometimes 15 feet long, and bore an immense horn rising from between the eyes.

Bibliography.—Consult authorities on zoology and sport in India, especially Blanford, 'Mammals of India' (1888); and in Africa, especially the writings of Selous and Baker; Flower and Lydekker, 'Mammals Living and Extinct' (1891); Woodward, 'Vertebrate Palæontology' (1898).

Rhinoceros-bird, some bird, especially a small white egret, which perches upon the rhinoceros when at rest, searching his hide for ticks and other insects, and warns him by its cries of the approach of any intruder. Compare BUREAU-BIRD.

Rhinocopy. See NOSE AND THROAT.

Rhio, *rē'ō*, or **Riouw**, *rē-ow'*, a seaport belonging to the Dutch, in the Indian Archipelago, on the islet of Tandjong Pinang, in a bay on the south side of the Island of Bintang, 50 miles southeast of Singapore. It is the capital of a Dutch residency, comprising the Rhio Archipelago, the Linga group, and the Tambelan, Anambas, and Natuna Islands, as well as the districts of Kampar, Siak, and Indragiri, on the east coast of Sumatra. The population of the residency is estimated at 108,000.

Rhizome, or **Rootstock**, in botany, a sort of stem found in herbaceous perennials, running along the surface of the ground, or partially or wholly subterranean, sending forth shoots at its upper end and decaying at the other. It occurs in the ferns, iris, etc.; and in the ferns it may be wholly covered with the soil. In the mints, the sand-sedge, couch-grass, and other plants the rhizome is long and slender, but in Solomon's Seal, iris, birthroot, etc., it is stouter. Unlike roots, rhizomes bear scaly leaves at the nodes, and they also send down fibrous roots. The stouter rhizomes may act as storehouses of food.

Rhode Island and Providence Plantations, one of the New England States, situated between lat. 41° 18' and 42° 3' N., and between long. 71° 8' and 71° 53' W.: bounded on the north and east by Massachusetts, on the south by the Atlantic Ocean, and on the west by Connecticut. The extreme length of the State from north to south is 48 miles, and the extreme width from east to west is 36 miles. The area is 1,250 square miles, of which 1,053 square miles, including the islands, are

land surface. The larger part of the State is hilly, but the general elevation is not great; the highest point, Durfee Hill, in the northwest of Providence County, having an altitude of 805 feet. The large inlet known as Narragansett Bay, ranging in width from 12 to 3 miles, and with lesser bays and inlets branching from it, extends 28 miles inland in a northerly direction. It includes a number of islands, Rhode Island, Conanicut, and Prudence Island being the largest. Rhode Island is 15 miles long and about 3 miles wide, and on it is situated the city of Newport, sometimes called the summer capital of the United States. Block Island lies nine miles from the coast. It is a hilly expanse of verdure-clad sand rising boldly from the Atlantic Ocean. The Great Salt Pond which was formerly enclosed within the island is now an open harbor, and other important improvements have been effected, making the island much more accessible and secure for steam and sailing vessels. The rivers of Rhode Island are small, but they supply the water used by great industrial establishments. The Blackstone and the Pawtuxet in the northern part of the State, and Pawcatuck in the south, are the principal streams. Three streams, the Wanasquatucket, Moshassuck, and West River, flow into the inlet known as the Providence River, which was in early times a widespread estuary, but which is now confined within narrow bounds. All the streams are rapid for the greater part of their course, and on some of them large dams have been built as reservoirs for the mills. These and the natural ponds add greatly to the picturesque effect of the scenery.

Climate.—The climate is mild, as compared with that of the greater part of New England. The mean temperature for January is 36° and for July 76°, and the humidity averages between 80 and 95 per cent throughout the year. The rainfall ranges from 40 inches in the northern part of the State to nearly 50 inches on the coast.

Geography and Minerals.—In the western part of the State the surface is chiefly composed of Archæan rocks, which in some places, as at Rocky Point, jut prominently into the bay. The bed of the bay itself, with its islands, and a large part of both shores, is composed of deposits from the Carboniferous period, but in the great terrestrial disturbances which geology tells us followed that period, the coal strata in the vicinity of Narragansett Bay underwent changes which greatly affected their value for use as fuel. Coal was discovered at Philipsdale, East Providence, some years ago; but the discovery was neglected until the recent high price of coal called attention to the mine as a possible source of local supply. It is claimed that the mine contains good hard coal, and can be worked profitably. A coal mine in Cranston, near Providence, which has been worked at intervals for many years, but never far from the surface, is being improved, and it is asserted that the quality is better the deeper the vein is followed. Excellent granite quarries are worked in different parts of the State, especially at Westerly, whence granite has been supplied for many notable monuments and buildings throughout the United States. Considerable deposits of magnetic iron ore are known to exist along the western edge of the Carboniferous

RHODE ISLAND

strata, and limestone is abundant in some parts of the State.

Agriculture.—Farming has not kept pace with other Rhode Island industries, the number of acres included in farms having decreased 17.8 per cent between 1850 and 1900. Much of this land taken from farms, however, has become sites for factories and villages, or been added to the suburbs of growing cities and towns. The average size of farms has decreased from 103 acres in 1850 to 83 in 1900, while the improved land of farms in 1900 is but a little more than one half as large as the improved area in 1850. This is due in some degree, doubtless, to the fact that many farms are occupied by persons who do not depend on them for a living, and do not cultivate their land to any extent. Farmers who do get a living from their land generally keep cows, and from these derive much, if not most of their income, and this accounts for the fact that hay and forage form the most important crop, occupying 68,000 acres in 1909, while corn amounted to only about 8,000 acres, and potatoes in 1909 to 6,000 acres. Cranston has probably the largest market-garden in the United States, and farmers raise considerable quantities of vegetables for the local markets, while fruit-raising is receiving increased attention.

The number of dairy cows kept is very large, being about 24,000, while the number of sheep has diminished from 11,400 in 1890 to 6,629 in 1900, owing to the increasing difficulty of keeping sheep where dogs are numerous, as in the vicinity of factory towns, and also because their care on a small scale in the East is no longer a sufficiently profitable occupation in competition with the large flocks of the West.

Fisheries.—Oysters, scup, menhaden, and squeteague are the most important products of the Rhode Island fisheries, which employ about 1,700 persons, and approach in value one million dollars annually. The fisheries of Narragansett Bay were menaced for a number of years by the pollution of the upper part of the bay with the sewage from Providence. This evil has been greatly alleviated, if not altogether removed, as a result of the methods of clarifying sewage recently adopted.

Manufactures.—Manufacturing is the leading industry of Rhode Island, which ranked second in 1900 in the production of cotton goods, and third in the manufacture of woollens, which last-named industry is giving way to worsted and knit goods, in which large fortunes have been made by manufacturers who had the discernment to note the change in popular taste.

Rhode Island is the parent State of cotton-spinning in America. English laws forbade anyone making a model or drawing of English cotton machinery, and sending it out of the country. Samuel Slater, an apprentice to cotton-spinning under Strutt, partner of Arkwright, the great inventor of spinning machinery, mastered the improvements on which he was employed, and came to the United States. Moses Brown invited him to Rhode Island. Slater went, and with the aid of Moses Brown's wealth he succeeded in producing by the close of 1790, at Pawtucket, R. I., cotton-yarn equal to the best made in England. Cotton-spinning became a great Rhode Island industry, and continued to be the leading industry until

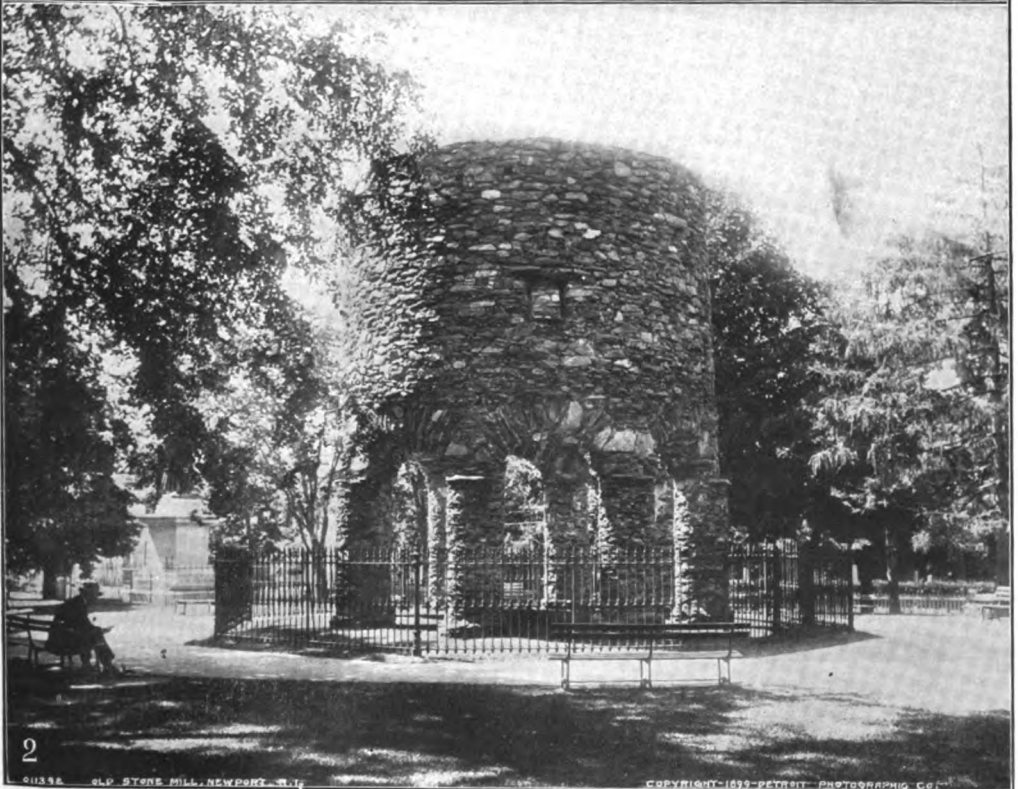
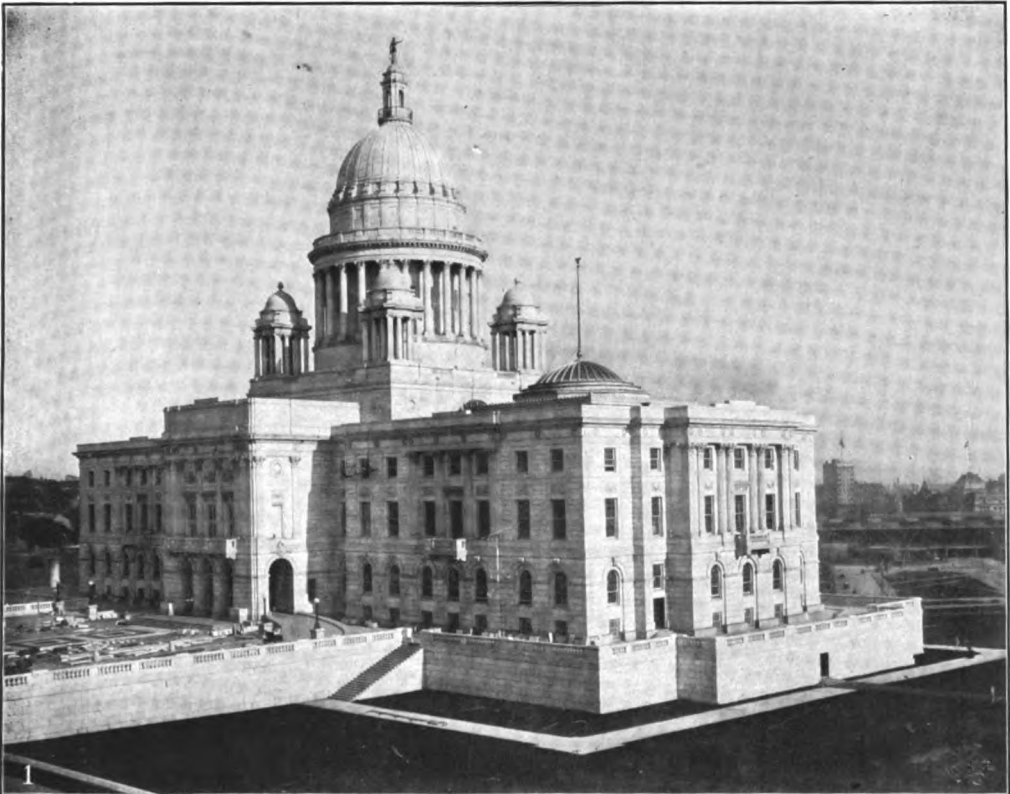
the attention of manufacturers was turned largely to woollens and worsteds. In 1900 the number of cotton spindles in the State was 1,920,522. The dyeing and finishing of textiles, the silk and silk goods industry, and the manufacture of rubber boots and shoes, and of electrical apparatus are also among the important and growing industries of the State. In the manufacture of the cheaper quality of jewelry Rhode Island stands first in the United States. In solid silverware the State has no superior. The iron industries are flourishing, and include locomotives, Corliss engines, screws—the gimlet-pointed screw being a Rhode Island invention—and all varieties of metal tools. The number of persons engaged as wage-earners in manufacturing in 1909 was 112,565, of whom over 25,000 were women, and over 5,000 children under 16 years of age.

Banks.—The Providence Bank, founded in 1791, is the oldest Rhode Island bank. The Providence Institution for Savings dates from 1819. The banking institutions of Providence include 36 national, 3 state banks, and 24 savings banks. The national banks had a total capital, according to the report of the Comptroller of the Currency for the year ending June 30, 1903, of \$12,305,000; surplus, \$3,788,000; cash, etc., \$1,523,000; loans, \$27,472,000; deposits, \$19,154,000. The state banks had capital of \$395,000; no surplus; cash, \$92,000; loans, \$1,003,000; deposits, \$735,000. The savings banks had surplus \$3,338,000; cash, \$2,343,000; loans, \$31,789,000; deposits \$71,900,000. A very large share of the banking business is in the hands of trust companies, with large capital and surplus. Since the liquidation of several banks carried down in the failure of A. & W. Sprague, 30 years ago, no suspicion has been attached to the solvency of Rhode Island financial institutions.

Railways.—The New York, New Haven & Hartford Railway controls the more important steam lines within the limits of the State, and the railway mileage was 209 miles in 1900. After many years of controversy over location and terms for the disposal of the Cove lands, a Union Station was erected in the city of Providence which added greatly to the convenience of travel in the State. A complete system of electric lines extends throughout the State.

Commerce.—The export commerce from Rhode Island ports is insignificant. Foreign imports at the port of Providence for the year ending 30 June 1909, amounted in value to \$1,569,484, and there are customs districts also at Newport, Bristol, and Warren. Congress has made liberal appropriations for the improvement of harbor facilities at Block Island. The wharves at Providence and other ports which once gave room to Indiamen, whalers, and privateers now accommodate steamers and other vessels used in the coastwise trade and summer travel. The boat-building industry of Bristol is known the world over on account of the Herreshoffs, who have constructed several successful defenders of the America's Cup. Narragansett Bay has become a pleasure resort from Providence River to Newport in the east and Point Judith in the west, and in this way a large amount of money is brought into the State, while wealthy men from New York and else

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1. The State House, Providence.

2. The Old Stone Mill, Newport.

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where, with summer homes in Rhode Island, have selected the State as their legal residence, and pay personal taxes there.

Finance.—Since the State recovered from the financial disorder occasioned by the War for Independence its credit has always been of the highest, and its obligations promptly met. The construction of the new State House at Providence, and other improvements due to the growing needs of the commonwealth have led to extraordinary expenditures within recent years (\$2,552,124 in 1910), and on 31 December 1910 the net indebtedness was \$4,051,094.20.

Population.—Rhode Island was the most densely inhabited State of the Union by the census of 1900, which gave 428,556 as the total population, or 407 inhabitants to the square mile. The population in 1890 was 345,506. The percentage of foreign population, that is, of residents of foreign birth, naturalized and unnaturalized, is very large, the total in 1900 being 134,509. The foreign element is chiefly of English, Irish, and Canadian origin, but the number of Swedes, Italians, and Russian Hebrews is increasing. The population (1910 Census) was 542,610.

Education.—Rhode Island has excellent public schools, supported by local taxation, and administered by local authority, and under the general supervision of a commissioner of schools. Education is compulsory, and while there is much illiteracy among certain classes of foreigners, parents, almost without exception, show eagerness to have their children educated. In 1908 the school population of the State was 102,084, of whom 78,410 were enrolled in schools. The large majority of teachers are females, the male teachers numbering only 195 out of the 2,314 employed in the schools in 1908, and the average monthly salaries are about \$115 for males and \$50 for females, the difference being due to the fact that the males are usually in the more responsible places. The State Normal School at Providence is a handsome building, and the State also maintains a College of Agriculture and the Mechanical Arts. The leading educational institution of the State, and one of the best in the United States, is Brown University (q.v.). A private corporation in the State is having constructed a school-ship called "Young America," to give Rhode Island boys and such others as desire it a first-class nautical and preparatory education. The Rhode Island School of Design furnishes educational advantages in the arts of the highest order.

Religion.—The First Baptist Church of Providence, said to be the first in America, dates back to 16 March 1639. Roger Williams was one of its organizers. The Quakers were among the early settlers, seeking refuge from persecution in Massachusetts, and the Friends' School at Providence is one of Rhode Island's best-known educational institutions. The Congregationalists did not venture into Rhode Island until 1721, and while their proposal to come there was received with some bitterness by the descendants of those whom their ancestors had driven into the wilderness, they have become one of the leading denominations in the State. While Roman Catholics were as free to worship in Rhode Island as members of any other creed, it was not until 1813 or 1814 that mass was publicly celebrated in the city of Providence,

and the Church of Saints Peter and Paul was completed in 1838. The present handsome Cathedral stands partly on the site of the old church, and the Roman Catholic faith now includes one fourth the population of the State. The Baptists have almost one third of the total Protestant church membership, and the Episcopalians, who celebrated in 1872 the 150th anniversary of old St. John's Church at Providence, have about one fifth. The Methodists date back in Rhode Island to 1787, and have a large membership and prosperous churches. The Universalists settled in Providence in 1772, and have since had a prominent share in the religious life of the State, besides having been instrumental in fostering many important public charities. The Presbyterians are increasing in numbers, and have flourishing places of worship. Rhode Island contains its proportion of other sects and creeds, including the Jews, who were among the early settlers of Newport, where some of them achieved eminence.

State Government.—There are 33 towns and 5 cities within the State. The governor is elected for one year, and a lieutenant-governor, secretary of State and other State officers are elected for the same period. The governor presides over the Senate, has no veto power, and can pardon criminals by and with the advice and consent of the Senate. The members of the legislature, known officially as the General Assembly, are elected for one year. In the upper house, called the Senate, there is one senator from each city and town. In the lower house, or House of Representatives, every town, no matter how small, has at least one member, but as no town or city can have more than one sixth of the 72 members to which the house is limited, the representation is not proportionate to population. Members of the General Assembly are paid for actual attendance, with a maximum limit of 60 days. The House alone has the power to impeach, and the Senate tries cases of impeachment.

The judicial power is vested in the Supreme Court, and in such inferior courts as the General Assembly may from time to time establish. Preliminary examination of persons charged with serious crimes, and trials for minor offenses are held in the district courts, the justices of which are chosen by the General Assembly. The justices of the Supreme Court are elected by the General Assembly in grand committee, and continue in office until their positions are declared vacant by a resolution of the General Assembly. In practice this has meant election for life, or until retirement by voluntary resignation.

History.—The colony originally consisted, as the name indicates, of more than one community of independent origin, but to Roger Williams, the founder of Providence Plantations, history accords the distinction of having established the commonwealth. Providence Plantations was founded in 1636 by Roger Williams, who fled with several companions from Puritan persecution. He was of Welsh origin, and of respectable family, and his arrival in Massachusetts, 5 Feb. 1631, is recorded as "the coming of a godly minister." Williams soon showed that he had no sympathy with the Massachusetts principle of controlling through the civil government the consciences of men, and he frankly

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avowed his views in this regard. He thus incurred the censure of the Puritan magistrates and it was at first resolved to expel him from the colonial bounds, and when it was learned that he proposed to found another colony, it was determined to send him back to England. Williams received timely warning of this intention, and he fled into the wilderness with several companions, and at the opening of spring in 1636 he began to plant on the east side of the Seekouk River. He had five companions, William Harris, John Smith, Francis Wickes, Thomas Angell, and Joshua Verin. Here he was not allowed to rest, being notified by Plymouth Colony that the place was within their jurisdiction. Some time between the end of April and the latter part of June 1636, according to excellent authority, he proceeded around what is now Fox Point and up Providence River, landing at the site of the future town, and here he selected a dwelling-place for himself and his associates. His object, as set forth by himself, was "the settling of the plantation, and especially for the receiving of such as were troubled elsewhere about the worship of God." How faithfully that object was carried out Judge Story related in an address on Rhode Island delivered many years afterward. "In her code of laws," he said, "we read for the first time since Christianity ascended the throne of the Cæsars that conscience should be free, that men should not be punished for worshipping God as they were persuaded. He required a declaration which to the honor of Rhode Island she has never departed from."

The settlement on Rhode Island was at first a separate colony, but it also owed its origin to the example and advice of Roger Williams. John Clark and others of Boston went to Providence in 1638 in search of an asylum where they might enjoy liberty of conscience. Roger Williams advised them to purchase from the Indians the large island on the east side of Narragansett Bay, called by the Dutch "Roode Eylandt." This was done, and the adventurers, 18 in number, incorporated themselves as a body politic and elected William Coddington their chief magistrate. A third settlement was formed at Warwick in 1643 by a party of whom John Greene and Samuel Gorton were leaders.

Roger Williams perceived that the union of the weak settlements and the protection of the home government were necessary for their protection from the hostile and comparatively powerful Puritans, and in 1643 he went to England, and brought back in the following year a charter which united the settlements of Providence and Rhode Island under one administration, the name of the colony being Rhode Island and Providence Plantations. The new government went into operation in 1647, when the freemen of the several plantations met at Portsmouth, 19 May, and adopted laws for carrying on the civil government. This charter was confirmed by Cromwell in 1655, and in 1663 Charles II. granted the celebrated charter which remained for 180 years the supreme law of Rhode Island, both as colony and State, and gave place to a State Constitution in 1843 only after the civil convulsion known as the Dorr Rebellion gave notice that the people were determined upon a change. This charter fully recognized the prin-

ciple of freedom of conscience which was the cornerstone of the commonwealth.

The colony suffered greatly in the war with King Philip. Providence was burned, and the outer settlements were laid waste, and settlers murdered. The Great Swamp Fight, on Rhode Island soil, broke the power of the hostile Indian confederacy, and when King Philip was slain by treachery in the fastnesses of Mount Hope, the red men ceased to be a menace to the security of the settlements.

When Sir Edmund Andros was made governor of New England by James II. he sought to take away the colonial charters, and in 1687 attempted to seize that of Rhode Island, but in some mysterious manner it disappeared and was not found until the accession of William and Mary in 1689. Roger Williams had died in 1683. Notwithstanding the harsh treatment he had received from the authorities of Massachusetts he was ever ready to use his influence with the Indians in behalf of the colonies, and he was instrumental in disarming Indian hostility at times when the colonists were ill-prepared for defense. Although a strong controversialist, and bold and unsparing in his denunciation of those with whom he did not agree, he had a remarkable faculty of commanding the affection and esteem of men, as was signally shown in his ability to obtain for his colony the protection alike of Cromwell and of Charles II. He was exemplary in his private life, and altogether worthy of the reverence which posterity, without regard to creed, attaches to the memory of him whom Whittier has truly called "soul-freedom's brave confessor." He imprinted on Rhode Island a character which it has never lost, and which has been handed down through all the varying changes of population, of liberality and tolerance, of the Sermon on the Mount interpreted in the ordinary every-day actions of men.

The colony grew with a steady and wholesome growth, and religion flourished, although unsupported by the compulsory contributions of worshippers. The people were engaged in agriculture and commerce, and, in times of war, in privateering. During the struggle between Great Britain and France for empire in North America, Rhode Island took an active share in supplying troops and seamen, and the colony had 50 privateer vessels, manned by 1,500 sailors, at sea in 1756. The passion for privateering, with its excitement, its tests of courage and endurance, and prospects of rich reward, became so strong that when Esek Hopkins was commander-in-chief of the Continental navy, with his vessels at Providence, he found it impossible to man them, owing to the fact that privateering offered better inducements. The coast of the colony was infested with pirates in the early part of the 18th century, and some 30 of these ocean highwaymen were hanged at one time at Newport.

It was difficult in earlier years to obtain men to fill the minor public places, and laws were passed which remained on the statute-books for many years, providing penalties for refusal to accept office. This modesty on the part of the forefathers is easier to understand in view of the fact that the expenses of the town of Providence at the outbreak of the Revolution did not exceed \$1,000 a year.

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The people of Rhode Island were among the foremost in defending American rights against the aggressions of George III. and his ministers. In June 1772 a band of volunteers commanded by Abraham Whipple, who had distinguished himself as captain of a privateer in the wars against the French, burned the British revenue schooner *Gaspee* in Narragansett Bay. During the greater part of the War of Independence Newport was occupied by the British, and on 29 Aug. 1778 a severe engagement was fought between the Americans, under Sullivan, and the British at Butt's Hill, R. I., in which the British suffered the greater loss.

Rhode Island was the last of the States to ratify the Federal Constitution, its assent not having been given until 29 May 1790, more than a year after the National government had gone into operation. As a small State Rhode Island was peculiarly jealous of its rights, and was slow to assent to its adoption. As the Constitution was first formulated and adopted by some of the original States there was room for a well grounded fear that the smaller States might be destroyed and absorbed through combinations of their more powerful neighbors. It was this fear mainly that caused Rhode Island to stand aloof from the combination, and it was not until that fear had been allayed by amendment to the original instrument that its adoption by the State was effected.

For some years after the Revolution the shipping of the State, being free from British restriction, became known in all parts of the globe then visited by vessels, and the foundations were laid of large fortunes afterward invested in manufacturing, when the shipping business declined. This change took place early in the 19th century, when New England's foreign commerce was practically ruined by the embargo, and when, on the other hand, the War of 1812 gave an impulse to domestic manufactures. Factories were established on every stream that afforded water-power, and Rhode Island grew in prosperity with her expanding industries.

The charter of Charles II., which continued to be the fundamental law of the State, restricted the right of suffrage to freeholders having an estate worth \$134, or renting for \$7 a year, and to their eldest sons. This was the cause of many wrongs, and of widespread popular protest. It was not uncommon for persons holding mortgages to threaten to foreclose them in order to influence votes, and the system gave rise to much intimidation and corruption. The conservative element strongly opposed a change, and when attempts to obtain reform through the regular course of legislation failed, representatives of the suffrage reform party met in convention and framed a constitution. They claimed that this constitution had been adopted by a majority of the adult male citizens of the State, and it was also alleged that a majority of those entitled to vote under the King Charles charter had voted in favor of the constitution. State officers and a legislature were chosen under this constitution, and organized with Thomas W. Dorr as governor. The charter officials, under Governor Samuel W. King, ignored the Dorr legislature and its enactments, and Governor King, at the head of a military force, dispersed the so-called insurgents. Dorr was

convicted of treason, and sentenced to imprisonment for life, but he was released some years later, and his sentence ordered expunged from the records of the State. A new constitution was adopted in regular form, and went into effect in May 1843. It retained the real estate qualification for foreign-born citizens, and this was not abolished until 1888. Another important change adopted within recent years was that permitting election by a plurality vote. This came into effect in 1893. When a majority was required the election was often thrown into the General Assembly, which sometimes chose a minority candidate. Until 1900 the State had two seats of government, the organization of the State government and one session of the legislature being held at Newport in May. Now all sessions are held in Providence, in the splendid new State Capitol.

As a manufacturing State, Rhode Island has been largely influenced by tariff interests in its attitude on National elections, and since 1856 it has always given its electoral vote to the Republican candidates. The Democrats have been successful several times within the past two decades, however, in electing their candidates for governor, and the present Governor, Lucius F. C. Garvin, is a Democrat. Rhode Island has adopted the so-called Australian ballot system of secret voting.

Political power is unequally divided. Each city and town, no matter how large or small, has but one representative in the Senate, or upper branch of the General Assembly, and the representation is also disproportionate in the lower branch. The city of Providence, with nearly one half the population of the State, and contributing nearly one half of the State taxes on general property, elects only about one eighth of the State legislature. In this respect Rhode Island is a miniature of the National government. It is also a singular fact that in Rhode Island's civil conflict, the Dorr "war," the northern part of the State chiefly supported one side, the Dorrists, and the southern part stood by the Charter.

In the Civil War Rhode Island supplied more than its quota to the National armies. General Ambrose E. Burnside, for a time in command of the Army of the Potomac, and whose equestrian statue is a conspicuous feature of the city of Providence, joined the service from this State, of which, however, he was not a native, and later was honored by its people by being elected governor and United States Senator. Rhode Island spared no expense in sending troops to the front, and since that great conflict has been generous in caring for her disabled and dependent defenders. The Soldiers' Monument opposite the City Hall in Providence (now about to be re-located), one of the finest in the United States, bears the names of the gallant dead who fell in defense of their country. In the Spanish-American War also, and the conflict in the Philippines, Rhode Island has been well represented.

EDWARD FIELD,

Author of the 'History of Rhode Island.'

Rhode Island, an island belonging to the State of Rhode Island; at the entrance to Narragansett Bay. It is separated from the mainland on the west by the estuary, Sakonnet River,

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and is the largest island in the bay. The State was named after this island. It is about 15 miles from north to south and three and one half miles wide. It is divided into three townships: Newport, Portsmouth, and Middletown. It is a famous summer resort. Newport (q.v.), the city, is on the southwest coast.

Rhode Island, Battle of, an engagement which occurred 29 Aug. 1778. The British had seized Newport and garrisoned it with 6,000 men under Pigott. An attack was concerted by Sullivan and Lafayette on land and Count d'Estaing on sea. Sullivan seized Butts' Hill on the island of Rhode Island. Estaing was obliged to meet Howe and the English fleet, but battle was prevented by a fierce storm, and Estaing withdrew to Boston to refit. Pigott attempted (29 August) to carry Butts' Hill, and a bloody repulse of the British resulted; but on the arrival of Clinton with 5,000 reinforcements the Americans were compelled to evacuate the position.

Rhodes, rōdz, Cecil John, South African financier and statesman: b. Bishop's Stortford, Hertfordshire, England, 5 July 1853; d. Cape Town 26 March 1902. He was educated at the grammar school of his native town, but before he could pass on to the university, a serious affection of the lungs necessitated his departure for Natal, where an elder brother of his was engaged in cotton-raising. Rhodes landed in South Africa in 1870 and after a brief experience in farming made his way to the diamond fields of Kimberley, where he met with speedy and astonishing success. At 19 he was a millionaire and, with his health well recovered in the salubrious air of the veldt, he planned to return to England to resume his interrupted education. Before leaving South Africa he traveled for eight months, by ox-cart and on foot through the region north of the Orange and the Vaal, and his imagination, which even at that early age worked in vast spaces, saw in the fertile, thinly populated country, virgin soil for the building up of an imperial Britain in the Dark Continent. He matriculated at Baliol College, Oxford, in 1873, but his ailment returned and he was compelled to leave England in the same year. Three years in South Africa made him robust again and from 1876 on he kept his terms at the university, spending the long vacation in South Africa, and taking his B.A. and M.A. in 1881. In the same year Rhodes entered the Cape Parliament as member for Barkly West. By this time his plans for the future had assumed a definite character. Convinced, at all times, of the supreme fitness of the English race for the task of governing the world, Rhodes made it his object in life to further the realization of that end in his own especial sphere of South Africa. To aid him in his schemes he looked to money, in whose power he had a tremendous faith, and it is because of the close connection in him of the selfish money-getting instinct and the broad ambition of the statesman that Rhodes remained for many years an enigma to the world. In the Cape Parliament Rhodes devoted himself to the task of establishing harmonious relations between the English inhabitants and the Dutch, for with true insight he recognized that if British influence was to dom-

inate South Africa it must be conditioned by the good-will of the people of Dutch blood. The first step in his scheme of imperial expansion was the acquisition of Bechuanaland as a British protectorate in 1884. For this he labored against the indifference of the home government, which he finally stirred to action by his insistence upon the necessity of securing Bechuanaland as an outlet for the British trade to the north, already threatened by the encroachments of the Transvaal from the east and Germany from the west.

The annexation of Bechuanaland was a victory for Rhodes over Kruger, the astute president of the Transvaal, but the struggle between the two did not end there. When Boer commanders began to cross the Limpopo River, the northern boundary of the Transvaal, about 1887, Rhodes, to cut off their advance in that direction, obtained from Lobengula, king of the Matabele who were masters of the country between the Limpopo and the Zambesi, the exclusive right to search for minerals within his territories, and in 1889 the British South Africa Company was incorporated with almost absolute political and territorial powers over a vast, indefinite tract north of the Limpopo. In 1890 settlers were brought into the country and founded Fort Salisbury in Mashonaland, and at the same time the construction of a railway was begun which, running entirely through British territory, was to connect the new settlements with the Cape. Reading his title to Rhodesia, as the country was soon called, in liberal terms Rhodes (after 1893) extended the operations of the company north of the Zambesi as far as to the southern end of Lake Tanganyika, and though his dream of an "all red" map of Africa had been dissipated by the convention of 1889 with Germany, which allowed that country to stretch a barrier across the continent to the Kongo State, he did not abandon his scheme of a transcontinental telegraph line from north to south and a railway "from Cape to Cairo." Upon his political projects Rhodes spent vast amounts of money, partly his own, partly the funds of the De Beers Consolidated Mines, a corporation formed by him in 1888 and controlling the entire diamond output of the famous Kimberley mines. Of this company he was managing director.

In 1890 Rhodes became premier of Cape Colony. During his six years of office he gave special attention to his old policy of amalgamation between Dutch and British; he succeeded in winning the confidence of the former by his strong advocacy of full local government for Cape Colony, which he considered quite consistent with, and indeed, essential for, the scheme of imperial federation. It is this belief in a federal union of locally autonomous commonwealths that explains his gift of £10,000 to the funds of the Irish Home Rule party in 1888. In his treatment of the native races of Cape Colony Rhodes maintained the impossibility of granting them equal rights with the white population, but at the same time held it necessary to protect them by law against the temptations of civilization and exploitation by the whites. In Rhodesia a formidable outbreak of the Matabele in 1893 ended, after a bitter conflict, in their utter defeat and the absorption of their

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territory by the Chartered Company. Successful everywhere, however, Rhodes was destined to fall before his old opponent, Kruger, of the Transvaal. The Jameson raid in 1895 destroyed Rhodes' personal power, although subsequent events fully vindicated his policy. Though the full truth of the Jameson affair may not perhaps be known, it is established that Rhodes, who was a large holder of mines in the Rand, plotted with other leaders of the Uitlanders in Johannesburg for the subversion of the Transvaal government; that a revolution was prepared in Johannesburg, and that Rhodes stationed Captain Jameson with several hundred men of the Rhodesian mounted police on the western border of the Transvaal to cooperate when necessary with the leaders in the mining town; and though it is also established that Jameson invaded the Transvaal without Rhodes' orders, the evil results of that unhappy affair may not unjustly be reckoned up against the premier of Cape Colony who abused the powers of his office to plot the downfall of a nation (see JAMESON, LEANDER STARR). A committee of the House of Commons acquitted Rhodes of responsibility for the raid, but censured his conduct as minister and director of the Chartered Company. Rhodes resigned the premiership on the last day of 1895 and thenceforth devoted himself to the interests of Rhodesia. A second war with the Matabele in 1896 was terminated by Rhodes' intrepid courage; the building of the trans-continental railway was rapidly pushed forward, and in connection with this undertaking Rhodes visited Europe in 1898-1900, carrying on negotiations with Mr. Chamberlain, the colonial secretary, and with the German emperor. During the Boer war, in its outcome the triumph and realization of his policy, Rhodes was besieged in Kimberley and took part in its defense. His health, however, gave way, and in spite of a trip to Egypt, his old disease finally conquered. In his lifetime Rhodes was the subject of infinite execration, as well as unlimited applause. Looked upon by different men as a statesman or a land grabber, a builder of empires or an unscrupulous speculator, he was all of these and more; and the anomaly of his character may, perhaps, be best explained if he be regarded as a man of great aims who let nothing stand in the way of their achievement.

Rhodes left the bulk of his great fortune for the establishment of a large number of scholarships at Oxford University to be apportioned as follows: Rhodesia, 9; Cape Colony, 12; Natal, 3; Australia, 18; New Zealand, 3; Canada, 6; Newfoundland, 3; Bermuda, 3; United States, 2 for each State and territory; Germany, 15. All but the German scholarships have an annual value of £300, and all but the last were intended to bring about that complete unity of the English speaking race whose destiny it is, Rhodes believed, ultimately to rule the world. Consult "Vindex," "Political Life and Speeches of Cecil Rhodes" (1900); "Imperialist," "Cecil Rhodes: a Biography and Appreciation" (1897); Hensman, "Life of Cecil Rhodes" (1902).

Rhodes, James Ford, American historian: b. Cleveland, Ohio, 1 May 1848. He studied at the University of the City of New York and

also at Chicago University, his courses being principally confined to history, literature, rhetoric and metaphysics. In 1867 he went to Paris and attended lectures at the Collège de France following which he pursued a course in metallurgy at the School of Mines in Berlin, and made a tour of inspection through the iron and steel works of Germany and Great Britain. In 1870 he entered his father's iron business in Cleveland and became a member of the firm in 1874. Having acquired sufficient wealth to enable him to adopt a literary career, he retired from business in 1885, and began the preparation of his "History of the United States from the Compromise of 1850." In 1891 he took up his residence at Cambridge, Mass., and the next year the first two volumes of his work were published. Five volumes have so far (1905) been published, carrying the work to the close of 1864. The author's design is to continue the history through the year 1885. The Loubat prize was awarded him by the Berlin Academy of Sciences in 1901.

Rhodes, Mosheim, American Lutheran clergyman: b. Williamsburg, Pa., 14 April 1837. He was graduated from the Susquehanna University, Selinsgrove, Pa., in 1861, was ordained to the ministry in that year and has since held charges in Pennsylvania and Ohio. He was president of the General Synod of the Evangelical Lutheran Church in 1885-6 and is an active promoter of religious educational movements. He has written: "Life Thoughts for Young Men" (1879); "Throne of Grace" (1887); "Scriptural Giving" (1898); etc.

Rhodes, an island of Turkey, in the Aegean Sea, near the southwest coast of Asia Minor, from which it is distant about 11 miles. It lies between lat. 35° 52' and 36° 28' N., and lon. 27° 40' and 28° 15' E., and has an area of some 560 square miles. The island is crossed from north to south by a high mountain range which attains its extreme elevation in the peak of Atairo, the ancient Atabyron, with an altitude of 4,070 feet. Hills of a lower level traverse the island in all directions and are covered with coniferous trees, the considerable remnants of once splendid forests. Along the many mountain streams tropic plants grow in abundance, chief among them myrtles, oleanders and cactus. The soil is fertile and on the hillsides and in the valleys and plains, vines and olives, figs, pomegranates and oranges are grown. Wheat of an excellent quality is also raised, but not in sufficient quantities to form a commodity of export. Rhodes has been famous since ancient times for the mildness of its climate and its salubrious air. The winds show little variation. The value of the foreign commerce is about \$1,000,000, the chief articles of export being sponges, oil and fruit. The island forms a *savjak* or district of the Turkish province of the Isles of the White Sea, and its capital Rhodes (q.v.) is the seat of a pasha. The population is placed at 30,000 of whom two thirds are Greeks, about 7,000 Mohammedans and 2,500 Jews.

The original inhabitants of Rhodes are to us unknown but at the dawn of history we first find the island inhabited by a mixture of races from Asia Minor, and Phœnicians, the latter of whom seem to have come from Crete. In the earliest period of Hellenic migrations Rhodes

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was overrun by the Dorians who founded the cities of Lindus, Ialysus and Kamiyus, the sites of which may still be identified. These cities with the three Dorian cities on the mainland, Cos, Cnidus and Halicarnassus, constituted the so-called Dorian Hexapolis whose common shrine was the temple of Apollo Triopis on the Carian coast. The sun-god was at all times the favorite deity of the island and from one of his most common emblems, the rose, its name (*rhodos* in Greek, "rose") is said to be derived. The Rhodians were among the most enterprising traders in the Mediterranean and their colonies were found in Spain, in southern Italy and Sicily, and on the southern coast of Asia Minor. In 408 B.C. the inhabitants of the three ancient towns abandoned their homes and joined to form the new city of Rhodes (q.v.) which from now on was the capital of the island. The foundation of Rhodes exercised a tremendous influence on the development of the trade of the island. In the Peloponnesian war, Rhodes sided with Athens until 412 B.C., when it went over to Sparta. In 394 B.C., however, it returned to the Athenian allegiance. Occupied by the Macedonians during Alexander the Great's lifetime, it revolted after his death and defended its independence with splendid success against Demetrius Poliorcetes in 304 B.C. The island was now at the very height of its power; its commerce attained an unprecedented development and by means of its strong navy it made itself master of a strip of territory on the Asiatic mainland. The Athenian orator Æschines (q.v.) established a noted school of oratory in the city of Rhodes, which also became a great centre for the arts, especially sculpture and one of the leading university towns of the Roman world. Early in the 2d century B.C. Rhodes became an ally of Rome and enjoyed its favors. In 42 B.C. it was plundered by Cassius because it sided with Julius Cæsar, and in 44 A.D. it was united to the province of Asia. In 661 the island was taken by the Arabs, but was recovered by the Byzantines who in 1310 gave it over to the Knights of St. John. The latter held it against the Turks until 1522, when it was taken by Solymán II. In 1851 and 1856 the island suffered from severe earthquakes.

Rhodes, or Kastro, a town and the capital of the island of the same name, situated at its northeastern extremity. The modern town is of much smaller extent than the ancient city, but is still of imposing appearance. It is built in the form of an amphitheatre and is surrounded by walls and a ditch dating from the time of its occupation by the Knights of St. John, the memorials of whom constitute the most interesting features of the town. Among these are the hospital, the palace of the grandmaster and the cathedral of St. John, the latter two in a ruinous condition. The streets are tortuous, the most picturesque being the Knights' Street, which has preserved its mediæval appearance. The town has three ports, the one to the north, the central, and the southeast port; of these the central port is the only one practicable, but is in part choked up with sand. Near the harbor in ancient times stood the famous Colossus (q.v.). The population is about 11,500, mostly Turks and Jews.

Rhodes, Colossus of. See **COLOSSUS**.

Rhodes Scholarships. See **RHODES, CECIL JOHN**.

Rhodesia, *rô-dê'zî-a*, South Africa, a British possession colonized in the last quarter of the 19th century by the British South African Company, founded by Cecil John Rhodes (q.v.), after whom it is named. It is bounded on the north and northwest by the Kongo Free State, on the west by Portuguese territory and Bechuanaland, on the south by Bechuanaland and the Transvaal, on the east by Portuguese territory and the British Central Africa Protectorate, and on the northeast by German East Africa. Total area, about 750,000 square miles. The river Zambesi, which traverses it from west to east, divides it into the two portions called Southern and Northern Rhodesia. Southern Rhodesia (area 174,728 square miles) consists of the two former districts of Mashonaland, capital, Salisbury, and Matabeleland, capital, Bulawayo. Northern Rhodesia is divided into two parts under separate administrators, namely Northeastern Rhodesia, headquarters, Fort Jameson, and Northwestern Rhodesia, headquarters, Lialui.

The river Limpopo forms the southern boundary, and the Matopopo Hills and their northeastern continuations form the watershed between the basins of the Zambesi and the Limpopo. Of the tributaries flowing north to the Zambesi, the most important are the Shanghani, Umfuli, and Panyame; and of those flowing south to the Limpopo the Bubyie, Tuli, Shashi, and Macloutsie. The whole country is a plateau varying in elevation from 3,500 to 5,000 feet above sea-level; and in Southern Rhodesia there are numerous mountain ranges, of which the chief is that of the Matopopo Hills already mentioned, Rhodes' burial-place. Of the individual peaks Mount Hampden near Salisbury, Hartley Hill, Mount Wedza near New Umtali, and Mount Inyanga are the best known. There appear to be no lakes of any importance apart from the great lakes on the frontiers of Northern Rhodesia (Tanganyika, Moero, etc.). The prevailing rock-formations are granite and metamorphic rocks, and rounded, projecting knobs of granite, often of fantastic appearance, form a striking feature in the scenery of many districts. The climate in the higher parts of the country is generally suitable for Europeans, but in the lower swampy parts and some of the river valleys malaria is prevalent, and the tsetse fly commits great ravages among cattle and horses. The area above 3,000 feet in Southern Rhodesia, most of which is adapted for the residence of Europeans, is stated at 100,000 square miles, and above 4,000 feet, where European children can be reared, there are 26,000 square miles. The summer season, from December to April, is characterized by great heat during the day and heavy rains, but during the rest of the year the weather is generally dry and much colder, especially in June and July. At Salisbury the mean July temperature is 57.5° F., the mean January temperature 70.5° F., and the extremes for the year are about 34° and 93°. The annual rainfall is about 33.8 inches, and falls on some 75 days. The soil in many parts is fertile, and the ordinary cereals, vegetables, and fruit-trees of Europe can be grown, in addition to the native crops of rice, tobacco,

RHODIAN LAW—RHODODENDRON

india-rubber, and cotton. Extensive tracts of land furnish excellent pasture. Gold has been worked in Southern Rhodesia from ancient times, and there are striking remains at Zimbabwe (near Victoria) and elsewhere, of the works erected by the early miners. At the present time little, if any, alluvial gold is found, but quartz-reefs are being worked with more or less success in various parts of the country, especially around Gwanda, Buluwayo, Gwelo, Sebakwe, Victoria, Umtali, Mazoe, Salisbury, Hartley Hill, Lo Magonda, Abercorn, and Selukwe. The total output of gold for the year 1900-1 was 106,783 ounces, valued at \$1,919,900. Coal, iron, copper, silver, tin, plumbago, and kieselsuhr have also been reported, and some of them are being worked. Southern Rhodesia is being rapidly opened up by means of railways, telegraphs, and roads. Buluwayo is in direct railway communication with Cape Town, 1,360 miles, and in 1899 the line from Salisbury to the Portuguese coast at Beira was opened for traffic. A line to connect Salisbury with Buluwayo is rapidly approaching completion, and other subordinate lines have been projected or begun.

The whole of Rhodesia, together with the treeless plain of Barotseland on the northwest, acquired in 1899, is under the administration of the British South Africa Company, which was incorporated by royal charter in 1889. Southern Rhodesia, however, is more directly under the control of the imperial government. The administration is carried on in accordance with the company's charter as amended by order in council of 1894 and 1898. The senior administrator, with headquarters at Salisbury, has an administrative council of six members and a legislative council of ten members, the latter including two elected representatives of each of the two great divisions of the province. The enactments of these councils are subject to the approval of the High Commissioner for South Africa, who acts through a Resident Commissioner. Jury trial was introduced in 1899. There are resident magistrates and judges, from whom an appeal lies to the Supreme Court of Cape Colony, and thence to the Judicial Committee of the Privy Council. Salisbury and Buluwayo have a regular municipal government, and doubtless this will be extended in time to the rising towns of Umtali, Gwelo, Tuli, Tati, Victoria, Wankie, Melsetter, Enkeldoorn, Charter, Gwanda, etc. The revenue in 1901-2 was \$2,176,200 and the expenditure \$3,552,800. The total native population of Southern Rhodesia is estimated at 510,000. The white population of Southern Rhodesia was about 11,300; of North-eastern Rhodesia, 164.

The chief tribe of original native inhabitants is that of the Mashonas, a peaceful and industrious race. In 1836 a Zulu people, known as Matabele, invaded the country under a chief called Mosilikatse, and easily conquered the indigenous inhabitants. For more than 50 years this warlike race held undisputed sway in Southern Rhodesia, and appear to have grievously oppressed the subject peoples, but in 1890 an expeditionary force equipped by the British South Africa Company occupied Mashonaland without opposition and founded the town of Salisbury. The Matabeles were for a time left undisturbed, but in 1893 their raids into Mashonaland gave the company an opportunity of

extending its authority. Three columns, one of them assisted by subjects of Khama, chief of the Bamangwato, advanced from the northeast, the east, and the southwest respectively upon Buluwayo, the capital of Lobengula, who had succeeded his father Mosilikatse as chief of the tribe. The Matabeles were easily overcome by means of the Maxim machine-guns, and fled to the hills. Toward the end of 1893 Lobengula sent overtures for peace, together with a sum of money, but the fatal cupidity of some men of the Bechuanaland police prevented these from reaching the company's officials. Accordingly the Matabeles who remained around the person of their chief, enraged by the supposed rejection of their overtures, surrounded a small party of Englishmen under Major Wilson, who, unable to escape, fought desperately till all were killed. Lobengula died early in 1894, and all resistance was at an end. Matabeleland has since formed a part of the company's dominion, but a serious native revolt, partly due to the ravages of rinderpest and locusts, broke out in 1896. Mashonaland also revolted about the same time, but both rebellions were peaceably settled by Cecil Rhodes' personal influence over the natives. Consult: Bent, 'The Ruined Cities of Mashonaland' (1893); Hall, 'The Ancient Ruins of Rhodesia' (1902); Hensman, 'History of Rhodesia' (1900); Knight, 'Rhodesia of Today' (1901); Leonard, 'How we made Rhodesia' (1896); Thompson, 'Rhodesia and its Government' (1898); Tort, 'Rhodesia Past and Present' (1897).

Rho'dian Law, an early system of marine law, said to have been compiled by the Rhodians after they had obtained the sovereignty of the sea. The only rule that we know now, though the entire code was adopted by the Romans under Antonius Pius, is the principle of general average: "If a cargo be jettisoned to lighten the ship, all contribute to make good the loss incurred for the benefit of all." The mediæval naval law of the Rhodians was not of Rhodian origin. It consisted of four distinct parts, of very different dates, but mostly of practical value.

Rho'dium, a metal belonging to the platinum group, discovered by Wollaston in 1804. It occurs in small quantities in various platinum ores; is a grayish-white metal; is very hard and infusible, scarcely softening in the flame of the oxyhydrogen blowpipe; and is unaltered in the air at ordinary temperatures, but oxidizes at a red heat. Insoluble in acids, it is readily oxidized by fusion with nitre. The specific gravity of fused rhodium is 12.1; its atomic weight is 103. The compounds of this metal have not been much studied.

Rhodochrosite, or **Dialogite**, native manganese carbonate. It is usually either cleavable-massive or in rhombohedral crystals of rose-pink or brownish-red color. Its lustre is vitreous to pearly; hardness, 3.5 to 4.5; rhombohedral, cleavage highly perfect. Its most important localities are in Hungary, Germany and Colorado, in which State many magnificent specimens have been found.

Rhododen'dron, a genus of shrubs and trees of the order *Ericaceæ*. About 200 species have been recognized, natives mainly of the cooler parts of the northern hemisphere. They

RHODOLITE — RHONE

are most numerous in eastern Asia; seven are indigenous to America. They are usually evergreen, have smooth simple leaves, and terminal umbel-like racemes of generally very showy flowers for which the plants are widely popular as ornamentals. A few species yield wood which is used in turning, and cabinet work, but more largely as fuel; the flowers of others are used in jelly-making, and the leaves of a few have been used medicinally. They are sometimes made to include azalea (q.v.) by some botanists, but are usually considered distinct, the azaleas being generally deciduous. Some species are only a few inches tall, others exceed 50 feet in height and 18 inches in diameter.

Rhododendrons are readily propagated by seeds, cuttings or layers usually under glass; but choice varieties are most frequently grafted upon seedling stocks. The seeds are very small and are generally sown in seed-pans during early spring in peaty, sandy soil. The seedlings are pricked off as soon as possible; the greenhouse kinds under glass, the hardy ones in cold frames until the following year, when they may be grown in nursery rows. When planted in the garden they should always be protected from heavy wind, and the full glare of the sun. The deep shade afforded by walls and hedges is, however, not generally desirable. They do not succeed well as a rule upon limestone, limy or clayey soils, but thrive best upon well drained, though moist loamy soils underlaid by porous subsoil. Since the roots lie close to the surface no cultivation can be given, but mulching may take its place. Pine needles, marsh or salt hay are specially desirable since they are free from weed seeds. Annual or biennial dressings of well rotted stable manure should be given. The seed vessels should be cut off when the flowers have fallen, to divert the plant food into new flower buds and to prevent the scattering of seed. The greenhouse kinds require very porous peaty soil, free watering during the summer, careful watering in winter, cold but not frigid quarters for the Himalayan species, and not less than 50° for the Javanese kinds which bloom and grow continuously and require more water also. These last also being epiphytes require still more open soil. They are exceptionally attractive when properly grown.

Among the American species the great laurel (*R. maximum*) is the largest, attaining a height of 30 feet or more. It is indigenous from Nova Scotia to Michigan and southward in the mountains to Georgia. In early summer when its rose or lilac flowers appear in profusion it is an imposing subject and is justly popular as a park specimen. If taken when small from loose soil in the woods it usually transplants well, but nursery-grown plants should be given preference. Though called *maximum*, several of the Asiatic species discovered since this was named are far larger. *R. catawbiense*, a species with lilac-purple flowers often 1½ inches in diameter, is one of the most beautiful of ornamental shrubs. It rarely exceeds 15 feet. In the mountains from Virginia to Georgia it is very common but in cultivation is well known as hardy in New England. It is one of the parents of a host of hybrid varieties of remarkable beauty.

R. ponticum, a native of western Asia and the Iberian peninsula, resembles *R. maximum* but

rarely exceeds 10 feet in height. It is considered less hardy than the preceding species, but is widely cultivated, especially in Europe. Several remarkably striking species were discovered by Hooker and other botanists in southern Asia, those of the Khasia Hills being especially noted. Only a few of these, however, have been introduced into cultivation and still fewer have been brought to America. Some have flowers four inches in diameter, others perfumed blossoms, and some are epiphytic in their habits.

Consult Bailey, 'Cyclopedia of American Horticulture' (New York, 1900-2).

Rhodolite, a beautiful light red variety of garnet (see GEMS), found only in North Carolina, highly prized as a gem, for which it has been extensively worked and sold within a few years past. The name is from the Greek *rhodon*, a rose, the color resembling some roses and rhododendrons, and unlike most garnets, becoming extremely brilliant by artificial light. Analysis shows that rhodolite is composed of two molecules of pyrope garnet with one of almandite garnet. It occurs intimately associated with the Cowee rubies (see RUBY) of Macon County, the crystals of the latter sometimes even enclosing the rhodolite. It is one of the most important gem-stones of North Carolina.

Rhodonite, a rose-pink or brownish-red triclinic mineral, essentially a manganese metasilicate, $MnSiO_3$. It usually contains some calcium and iron, while zinc is present in the variety fowlerite, which occurs at Franklin Furnace and Ogdensburg, N. J., in groups of magnificent crystals several inches in length. Sweden yields attractive specimens, and masses of much beauty associated with braunite are found at Cummington, Mass. Its most important occurrence is near Ekaterinburg, in the Ural Mountains, from which locality the Russians have for many years mined considerable quantities as an ornamental and semi-precious stone, for which purposes it is highly esteemed, being cut into pillars, mantels, table tops, jewel caskets, etc. Its hardness varies from 5.5 to 6.5. Crystallized specimens show an eminent cleavage; the massive forms are exceedingly tough, like jade.

Rhodope, *röd'ö-pē*, ancient name of a mountain chain (7,474 feet) extending along the borders of Macedonia and Thrace. The Turks call it Dospad Yailasi, the Bulgarians Despoto Dag, both titles having reference to the numerous (Greek) monasteries that stud its sides. Of these the most famous is the vast fortress-monastery of Rilo, in the northwest of the range, standing on its south side in the midst of magnificent pine forests. Rilo has for generations been the focus of the national Bulgarian Church and the mainstay of Bulgarian nationality.

Rhondda, *rönd'dä*, a river and town of South Wales, in Glamorganshire. Its valley is the seat of a large population engaged in coal-mining and metallurgical industries. The inhabitants are employed mainly in collieries, iron-works, etc.

Rhone, *rôn*, a river of Europe which rises in Switzerland, near the east frontiers of the canton of Valais. Its precise origin is commonly said to be in the Rhone glacier, between Mount

Furca on the east, the Gallenstock on the north, and the Grimsel on the west, 5,581 feet above the level of the sea; but the natives give the name of Rhodan or Rotten to three springs situated in a single basin at the foot of the Mayenwand, at an elevation of 5,282 feet, the water of which flows with an equal temperature in summer and winter (61° to 63° F.), and these they consider to form the true source of the Rhone. The waters from these springs join the stream from the glacier at a very short distance from their origin. The young river dashes down with great rapidity into the valley beneath, leaping from cascade to cascade; traverses the centre of Valais in a westerly direction, and near Villeneuve enters the Lake of Geneva at its eastern extremity. On entering the lake its waters are surcharged with mud; but on issuing from it, at its southwest extremity, at the town of Geneva, it is of a pure deep blue color, soon after changed into a muddy brown by the accession of the glacier-born Arve, which joins it 1½ miles below Geneva. Proceeding southwest to the frontiers of the department of Ain in France, it turns almost due south, forming the boundary between that department and Savoy; then turning suddenly northwest, traces the boundary between the same department and that of Isère, and reaches Lyons. Here, having at least doubled its volume by the accession of the Saône, it proceeds almost due south, separating the departments of Rhone, Loire, Ardèche, and Gard on the west, from the department of Isère, Drôme, and Vaucluse on the east. On approaching Avignon it takes a more circuitous but still southerly course, separates the department of Gard from that of Bouches-du-Rhône, traverses part of latter department, and finally falls into the Gulf of Lyons in the Mediterranean. At Arles it divides into two branches, the less of which, under the name of old Rhone, flows southwest, forming the west side of the large delta, known by the name of the Ile de Camargue. The main branch, under the name of Grand Rhone, continues its southerly course, but again divides into two branches, and enters the sea by two mouths. Its whole course is about 580 miles, of which 200 miles are in Switzerland, and 380 miles in France. It is navigable for 360 miles. By means of a series of magnificent canals, the navigation of the Rhone has been continued, without interruption, to the Rhine (through the Saône), Seine, Loire, and Garonne.

Rhopalac'eræ, butterflies (q.v.); see also LEPIDOPTERA.

Rhubarb, Wine Plant, or Pie Plant, several species of perennial herbs of the genus *Rheum*, order of *Polygonaceæ*. They are natives of Asia and eastern Europe and have generally very large radical leaves with thick fleshy petioles, and small greenish or whitish flowers in racemes or paniculate fascicles which are borne on stout stalks well above the foliage. Several of the species are valued for bold effects in ornamental gardening, and some have been used in medicine, but the most important species is the common rhubarb (*R. rhaponticum*) which has long been cultivated in gardens for its tender, acid, esculent leaf-stalks which are largely used for making pies, sauce, and preserves in spring, and to a less extent for

home-made wine from the juice. The plants are usually propagated by means of divided roots, though seed is also used. They thrive best in rich, light, friable loamy soils, well drained but moist, and given liberal applications of manure of all kinds. The plants should be set not less than three feet apart each way, given clean cultivation until the foliage shades the ground, and mulched with stable manure during the winter. When two years old the stalks may be used freely. They are most easily gathered by bending them down while being pulled. The earliest stalks are obtained by inverting a barrel over the plants and heaping manure around it. But for forcing, the roots are dug in autumn, allowed to freeze, covered with earth or sand in cellars, under greenhouse benches, etc., and watered. After producing a crop the roots are thrown away. Large quantities are cultivated in the Southern truck gardens, but the forced stalks are considered superior and generally command higher prices.

Turkey rhubarb, formerly popularly used in medicine, is supposed to be derived from *R. palmatum*, but the exact species seems to be still undetermined. Chinese Tartary and parts of China were the principal shipping countries, but Asia Minor was also a producer.

Rhumb-line, a line described on the earth's surface by a ship sailing steadily in the direction of any one point of the compass, except one of the four cardinal points. A rhumb-line laid down on a map drawn on the principle of Mercator's projection is a straight line cutting the meridians at a constant angle; but if a rhumb-line be drawn on a globe, so that it will cut the meridians all at the same angle, it will be found to be a spiral curve such that however far it may be produced it will always approach the pole, but never reach it.

Rhus, a genus of the cashew-nut family (*Anacardiaceæ*). It is found all around the world, and the species are generally shrubs, with simple or compound leaves, and small five-merous flowers in panicles. The fruit is a dry, one-seeded drupe, often in conspicuous masses. Some, like the American staghorn sumac (*Rhus typhina*), with its tropical appearance and the smoke-tree (*R. cotinus*) are planted for ornament; and the *R. coriaria* is cultivated along the Mediterranean for its leaves, a valuable material for tanning leather, when a fine white color is desired, as in light morocco. The foliage of some other species is also gathered for the same purpose. The American aborigines used *Rhus* berries for red, and the juice for black dyes, and the bark of *R. glabra* is employed as a mordant for red colors. Oriental lacquer is made from juice exuding from incisions in the bark of *R. vernicifera*. Many species, including the *R. toxicodendron*, which, like *R. vernix*, is poisonous to the touch (see PLANTS, POISONOUS), are used in medicine, and the acid fruits of certain species are made into cooling drinks or sharpened vinegar. Chinese galls are produced by *R. semialata*, and candlewax is expressed from the berries of the wax-tree (*R. succedanea*), and from *R. vernicifera*, often planted in Japan, for that purpose. One or two species furnish a useful wood.

Rhyacolite, a variety of orthoclase, occurring in glassy crystals in the lavas of Vesuvius, Italy.

RHYME

Rhyme, a stanza in which two or more lines end in a similar sound; also two or more final syllables having the same sound. Since rhyme, in the latter sense, is the most prominent mark of versification to-day, the word is usually understood to refer to the coincident sound at the ends of the verses. Rhyme was used, in a sense which has now become obsolete, to mark similarity of syllabification in other portions of the line than at the end. Thus the old writers speak of rhyming words when they mean words beginning with the same consonant, that is, in alliteration; also, in Spanish and Portuguese what we now call assonance—a coincidence of vowels in corresponding syllables, without regard to the consonants—was also called rhyme. Rhymes of to-day demand agreement in final syllables of the sound of the vowels and the succeeding or interposed consonants, if there are any, with a dissimilarity of preceding consonants, if there are any. Rhymes of such a character are of three kinds in English: single, or of one syllable, as flap and slap; double, or of two syllables, as greeting and fleeting; triple, or of three syllables, as merrily and cheerily. The single rhymes are often called male, and the double, feminine rhymes. The triple rhyme is used, in English, principally in verse of a conversational or comic or facetious nature. Rhymes of more than three syllables are practically unknown in all except the Persian language and its branches. In the perfect rhymes of to-day the preceding consonants, it has been stated, must not be the same; thus, partake and lake make perfect rhymes; but not partake and take, which makes an inelegance to the ear. The final syllables, moreover, of the perfect rhymes must both be accented; thus butterfly will not rhyme with terribly, although the final syllables are suited in other respects for rhyming. There are, however, rhymes which occupy middle ground—permitted by the exigencies of the occasion in which they are used (known as poetic license)—which are not to be tolerated in ordinary occasions or if frequently used. Such rhymes are those that nearly coincide in sound, and which do not offend the ear by failing entirely to do so. Thus gone may be rhymed with alone under poetic license. There is no rule by which a permissible imperfect rhyme may be determined and the only criterion is to be found in good usage as established by the better class of authors. Some languages incline more to the male rhyme, as the English, on account of its superabundance of monosyllables; others, as the Spanish and Italian, more to the female; the German and French possess an almost equal store of both. The female rhymes in French all contain an *e* mute in the last syllable; and from the beginning of the 16th century it has been the almost uniform practice among French poets in dramatic, heroic, elegiac, satirical, and other forms of poetry to make couplets of male rhymes alternate with others of female rhymes. In the ode combinations of rhymes are used, but always regular. When two successive lines rhyme they form a rhymed couplet, the measure used by Pope in his famous 'Essay on Man.' Three successive rhyming lines form a triplet; four a quatrain, but there may be two pairs of rhymes in a quatrain. Rhymes are used throughout poetry in accordance with the author's own taste

and inclinations. In some poetry every line is rhymed with some other. And this may be an adjacent line or one separated from its partner by one or more lines which do not end with the same rhyme, but with some other. The position of the rhyming pairs in the stanzas must be the same in each verse of the composition, and, moreover, within the stanzas the rhymes must occur regularly, according to some fixed scheme. In long poems, indeed, it is not infrequently the case that different portions of the poem employ stanzas in which the rhyme schemes differ. This is permissible because, on account of the length of the composition, the effect is the same as if it were composed of several shorter poems.

It is not necessary that every line in the poem should rhyme, and some of the pleasantest effects have been produced by the use of a mixture of rhyming and not-rhyming lines. When rhyme is totally absent poetry is spoken of as blank verse. The rhyme does not always occur only at the end of lines. It sometimes occurs at two places within the line, at the middle and at the end. But this is only a supplementary or secondary rhyme; it is not to be used except in conjunction with lines which have proper or terminal rhymes.

The rhyme scheme employed, in conjunction with the kind of measure used, determines the structural character of poetry (q.v.). The most complex forms now used in English are found in the sonnet (see **POETRY**) and in the Spenserian stanza, so-called because adopted by Spenser and used in his 'Faerie Queene.' There are a number of artificial forms of verse known as the French forms, because invented and brought to perfection by the poets of that nation, in which the positions of the rhymed lines vary greatly not only in the stanzas, but in the poem as a whole. The most commonly employed of these forms are the triolet, rondel, rondeau, villanelle, and ballade.

The modern use of rhyme was not known to the ancient Greeks and Romans. We meet, indeed, with some rhymed verses in Ovid, in which the rhyme was evidently intentional; but these examples are rare. It has been used, on the other hand, from time immemorial among the Chinese, Hindus, Arabs, and other oriental nations. Rhyme began to be developed among western nations in the Latin poetry of the Christian Church. It is found used as early as the 4th century, and in subsequent centuries grew to common use in the writings of church officers and ecclesiastical students. The use of rhyme in the vulgar dialects of Latin was even more general than in ecclesiastical poems, as is shown by the poetic monuments of the Romance nations belonging to the 9th and 10th centuries. In the Latin poems of the Fathers of the Church of the 4th century rhymes are more frequently used. The most ancient relics of Teutonic and Scandinavian poetry are not in rhyme, but are distinguished by alliteration. The earliest use of rhyme in a Teutonic dialect is in Otfrid's 'Evangelii,' written in Frankish, in the latter part of the 9th century. The oldest forms of rhymed verse are the couplet and the continuation of one and the same rhyme through a whole piece. The oldest poems of the Chinese, Indians, Arabians, and of other ancient peoples are rhymed; so are those of the Irish and the

Welsh. In the fragments of the earliest Latin poetry yet found, where the metre is accentual, not quantitative there is a marked tendency toward rhymed endings. This tendency was lost for a time under the influence of Greek poetry in which the measures are quantitative. Still the partiality for rhymes was not lost, as is proven by the verses of Ovid, and upon the decline of classicism (see ROMANTIC) they became common. An attempt at sustained rhymed verses can be found as far back as the 4th century, as evinced in the verses of Hilary. By the end of the Middle Ages rhymed Latin verse had reached its perfection. (See LOGOÆDIC VERSE.) For a general discussion of rhyme schemes and verse-forms consult G. L. Raymond's 'Rhythm and Harmony in Poetry and Music' (1895); Guest's 'History of English Rhythms' (1838); Parson's 'English Versification'; R. C. Trench's 'Sacred Latin Poetry.'

Rhymer, Thomas, the familiar name of an early Scottish poet, whose real name is supposed to have been Thomas Learmonth. He flourished in the latter part of the 13th century at Ercildoune (modern Earlston), Berwick. To this day the name of Thomas the Rhymer is popularly known in Scotland as that of a prophet, who derived his powers from residence in Fairyland; and it is only through the discovery of the manuscript of a metrical romance called 'Sir Tristram' (supposed by Scott to be his work, though this is still a matter of dispute) that he has acquired a better claim to remembrance. A good edition of the 'Tristram' is that of McNeill (Scottish Text Society, 1886). Consult also Murray's edition of the 'Romance and Prophecies of Thomas of Ercildoune' (Early English Text Society, 1875); Scott's 'Minstrelsy of the Scottish Border' (1806); and Child's 'Popular Ballads' (Pt. ii., 1884).

Rhynchocephala, rĭn-kō-sĕf'a-lā, a sub-order of very ancient prosaurian reptiles, fossil chiefly in the Old World Triassic, having much superficial resemblance to lizards, and perhaps in the direct line of ancestry, by way of *Sphenodon* which still survives as a key to the group. They were unarmored, terrestrial, lizard-like creatures, varying in length from a few inches to six or eight feet. Important genera are *Rhynchosaurus*, *Hyperodapedon*, *Homæosaurus*, found in Europe and India. The most remarkable genus, however, is *Sphenodon* (or *Hatteria*), one species of which is still living in New Zealand. See TUATERA.

Rhyolite, a silicious porphyritic rock resembling granite in chemical composition. The name was first given by Richthofen to igneous rocks in Hungary distinguished from trachyte mainly by a more varied texture and the presence of quartz. The western Cordilleras of America, as well as like regions elsewhere, contain rhyolite in vast areas. Rocks of the same or similar structural character are now known also under the names of liparite and nevadite. The rocks which petrographers formerly classed among felsites are now mainly described under the name of rhyolite, which includes a much greater number of varieties.

Rhys, rēs, Ernest, English author: b. London 17 July 1859. He was educated at Bishop's Stortford and Newcastle-on-Tyne and in 1877 became a mining engineer. In 1885, however, he

turned his entire attention to literature and in 1887 made a lecturing tour in the United States. He was editor of the Camelot series of reprints and translations (65 vols., 1886-91), of 'The Lyric Poets' (12 vols., 1894-9), and other publications and has written: 'The Great Cockney Tragedy' (1891); 'Welsh Ballads and other Poems' (1898); 'Frederick Lord Leighton' (1898); 'The Whistling Maid' (1900); 'Celtic Lore' (1901); 'Ogam-inscribed Stones Preserved in Dublin' (1902); etc.

Rhys, John, Welsh Celtic scholar: b. Ponterwyd, Cardiganshire, 21 June 1840. He was educated at Bangor Normal College for the teaching profession; kept a school in Anglesey till 1865, and in 1869 was graduated from Oxford. Continuing his studies at the Sorbonne and Collège de France in Paris, Heidelberg, Leipsic, and Göttingen, in 1871 he was appointed inspector of schools for Flint and Denbigh, and in 1877 professor of Celtic in Oxford University, becoming in the same year an honorary fellow of Jesus College, of which he has been principal since 1895. He was already known as a Celtic scholar before the publication, in 1877, of his 'Lectures on Welsh Philology' gave him a high reputation in this department of scholarship. Later works are: 'Celtic Britain' (1882); 'Origin and Growth of Religion as illustrated by Celtic Heathendom' (1887); 'Studies in the Arthurian Legend' (1891); 'The Early Ethnology of the British Isles' (1891); 'Inscriptions and Languages of the Northern Picts' (1892); 'Celts and Pre-Celts; The Welsh People' (1900), in collaboration with J. B. Jones; and 'Celtic Folk-lore' (1901). He has also edited various Welsh texts in conjunction with J. G. Evans.

Rhythm, rĭthm, in metrics, the measure of time or movement by means of a numerical proportion or harmony. In prose literature it follows no regular law, but consists in an arrangement of words in an expressive succession. This arrangement may at times approach the regularity observed in rhythm in verse; and the term prose-poetry has been applied to the prose in which such regularity is strongly marked. In poetry, rhythm is reduced to law, and consists in a regular succession of arses and theses (long and short; accented and unaccented syllables). This results in a precise cadence, or variety of cadences; modified, of course, by the pauses necessary to rhetoric. See PHRASE.

Rhyt'na. See SEA-COW.

Riall, ri'al, Sir Phineas, British military officer: b. County Tipperary, Ireland, 15 Dec. 1775; d. Paris, France, 10 Nov. 1850. He entered the British army as ensign in 1794 and became major in the same year. In 1804 he was attached to the 15th Foot, and in 1808-10 commanded a brigade in the West Indies. He was promoted major-general in 1813 and ordered to Canada to participate in the war against the United States. He served on the Niagara frontier and was chief in command in the campaign against General Jacob Broun in the following summer. He was defeated at Chippewa and at Lundy's Lane, being severely wounded and taken prisoner in the latter engagement. He was appointed governor of Grenada in 1816, was knighted in 1833, and in

1841 received full rank as general. Consult: Morgan, 'Sketches of Celebrated Canadians and Persons Connected with Canadian History' (1862).

Rialto, *rē-āl'tō*, (1) the principal bridge of Venice (q.v.), the only one spanning the Grand Canal. It consists of a single arch 90 feet in span and 24 feet high, and was built of marble at a cost of over \$500,000, in 1590. Two ranges of shops divide the bridge road into three narrow parallel streets. Shakespeare mentions the bridge and contiguous promenades as a rendezvous in 'The Merchant of Venice,' and the term has become synonymous with the meeting places of the theatrical profession in most populous centres. (2) The Rialto in New York was first applied to the section on 14th Street, between Broadway and Fourth Avenue; but has now extended to the west portion of Broadway, between 23d and 32d Streets.

Riazan, or **Ryazan**, Russia, (1) city, capital of the government of Riazan; on the Trubesh, a branch of the Oka. It is in an agricultural region; in which the chief product exported is rye. The chief manufactures of the city are woolen and linen goods, leather and needles. Nearby is the village of Grishina, in which are large cutlery works. Pop. about 48,000. (2) The government of Riazan has an area of 16,254 square miles. It is drained by the Oka and its tributaries. The chief manufactures are cotton, linen, and woolen goods, and leather. Rye is the principal grain exported. Pop. about 1,900,000.

Rib. The ribs are a series of flattened, narrow bones which together with the sternum in front and the vertebral column behind form the bony cage which encloses the thoracic organs and supports the muscular structures surrounding the chest cavity. In man there are 12 pairs of ribs, of which the first seven articulate directly with the sternum by means of their costal cartilages and are called the *true* ribs. The cartilages of the eighth, ninth, and tenth ribs join the cartilage of the seventh rib and are, therefore, termed *false* ribs, while the eleventh and twelfth ribs are free at their anterior extremities and are spoken of as the *floating* ribs. The seventh rib is the longest of the series, the others decreasing progressively in size to the first and to the twelfth. The seventh is considered the most representative rib, and is described as having an anterior or sternal extremity, a shaft, and a posterior or vertebral extremity. The sternal end is hollowed slightly to receive the cartilaginous prolongation by which it is connected with the sternum. The shaft is flattened and has an external and an internal surface. Its lower edge is slightly grooved to shelter the intercostal vessels and nerve which run parallel and close to it. The head presents two facets which articulate with the bodies of two adjoining dorsal vertebrae, and the neck is the short portion between the head and the beginning of the shaft. At the junction of the neck with the shaft there is a small swelling called the tubercle which has an articular facet for contact with the transverse process of the lower of the two vertebrae with which the head articulates, and a roughened area for the attachment of a ligament. The rib presents two curvatures, one around a ver-

tical axis, and the other about a horizontal axis, the effect of which is that the bone cannot be laid on a plane surface in such a way that both ends and the shaft between shall be in contact with it. The point at which the curvature is most acute is called the angle of the rib. Most of the ribs are so placed in the body that their sternal extremities are much lower than their points of attachment to the vertebral column, and through this arrangement as well as their peculiar curvature, when they are raised in inspiration the capacity of the thorax is increased both in its anteroposterior and lateral diameters. In some diseases, notably rickets (q.v.) and emphysema (q.v.) which are characterized by changes in the shape of the chest, the ribs undergo alteration in curvature. In children having rickets the anterior portion of the ribs sinks in so that the sternum becomes more prominent and the ends of the ribs may be enlarged and beaded, forming what is called the "rachitic rosary." If, in addition to rachitis there is present some respiratory obstruction from such causes as adenoids, nasal catarrh, etc., the "pigeon" or "keel" breast may result. In this the lateral compression is carried to a more extreme degree and the cross-section of the chest approaches the triangular shape with the apex forward. A funnel-shaped depression over the lower point of the sternum is sometimes caused by rickets, but may be congenital or due to the habitual pressure of a work bench or tools, as in cobblers, for example. In the emphysematous chest the ribs are thick and run more nearly horizontal so that an increase in the anteroposterior direction and outward bulging of the middle portion are caused, giving rise to the so-called barrel-shaped chest. The flat chest is the opposite of this, as its name implies, and has a short anteroposterior diameter. It is often associated with a tendency to pulmonary tuberculosis. Very rarely the ribs are more or less numerous than normal, but a not unusual deformity is the nonattachment of the anterior end of the tenth rib, so that it, too, is a floating rib. This abnormality is by some authorities considered as an indication of a tendency to neurasthenia. Fractures of the ribs are not infrequent injuries. Owing to the more sheltered position of the upper and the greater mobility of the lower members of the series it is most often the fourth to the eighth ribs that are fractured. Unless there is some complication, such as internal injury, the outlook is usually good. The treatment consists chiefly in immobilizing the side of the chest affected by adhesive plaster strapping. In treating collections of purulent fluid in the pleural cavity, it is often necessary for the surgeon to resect portions of one or more ribs in order to secure free drainage. See ANATOMY, OSTEOLOGY, THORAX.

Ribalta, (1) **Francisco de**, Spanish painter: b. in Castellon de la Plana, Valencia, about 1550; d. Madrid 12 Jan. 1628. Of the Spanish school of painting, he studied first in Valencia, and afterward in Italy, where he came under the influence of Raphael, Piombo, and the Carracci. Returning to Spain he was received with honor, and engaged to paint pictures for many churches and convents in Valencia. His work is remarkable for grandeur of conception, good taste in composition, freedom of drawing, and correct anatomical design, but like other Spanish paint-

ers he was an extremist, depicting alternately agony and ecstasy. Among his best pupils were his son Juan (q.v.), Ribera (q.v.), known as Lo Spagnoletto, and Gregorio Castenada. Of his paintings perhaps the best are: 'Dead Christ and Angels,' 'Saint Francis,' 'Blessed Soul,' and 'Lost Soul,' in the Madrid Museum; 'Saint Francis Embracing Christ,' 'Saint Peter,' 'Conception,' and 'Saint John Baptist,' in the Valencia Museum; 'Virgin and Saint John Returning from the Sepulchre,' at Munich; and 'Saint Joachim and Saint Anne,' 'Christ on the Cross,' and 'Magdalen at Sepulchre,' at Saint Petersburg. He also painted portraits of many prominent Valencians. (2) JUAN DE, his son, flourished about 1597-1628. He painted so nearly in his father's style that their works are often confounded. When 18 he painted the admirable 'Crucifixion' in the Valencia Museum. Among his works are: 'Saints John and Matthew,' 'Saints Mark and Luke,' and 'A Singer,' in the Madrid Museum; 'Pope Gregory the Great Celebrating Mass,' in the Dresden Museum; 'Jephtha's Sacrifice,' and the 'Martyrdom of Saint Catherine.'

Ribault, rê-bô, or **Ribaut**, Jean, French soldier and colonist in the New World: b. Dieppe about 1520; d. Florida 1565. A Huguenot, he was sent by Admiral Coligny to establish a colony of French Protestants in North America. He went out in 1562 with an advance party, with which he built a fortress at Port Royal in the present South Carolina. A garrison of 30, left by him in charge, finally mutinied, and, having slain their leader, set out in a crazy vessel for France. Half-famished, they were carried by an English cruiser to London. Ribault was made governor of a proposed colony in Florida in 1564, and sent out René de Laudonnière, who built Fort Caroline near the mouth of the St. John's. In May 1565 Ribault himself with seven vessels and a force of 300 set sail for the colony, where he arrived 28 August. A Spanish expedition under Pedro Menendez de Avilés, had, shortly after Ribault's arrival, begun work on intrenchments on the site of St. Augustine, and Ribault determined on an attack before the fortifications had been completed. His ships, however, were wrecked in a hurricane, and Menendez, marching overland, captured Fort Caroline and butchered almost all whom he found there. Ribault, with most of his force, was saved, endeavored to return, but was intercepted by Menendez, and with a portion of his followers were murdered. This ended the Huguenot colony in Florida. Consult: Gaffard, 'La Floride française' (1875); Parkman, 'Pioneers of France in the New World' (1885).

Ribbeck, Johann Karl Otto, German philologist: b. at Erfurt, 23 July 1827; d. 1898. In early life he went to Berlin, where he studied under Lachmann, Bopp, and Böckh, and from there to Bonn where he was a close student of the methods of Welcker and Ritschl. Having received his degree in Berlin and traveled for a year through Italy, in 1853, he returned to Berlin, where he entered Böckh's school. He then became a teacher, being called successively to Elberfeld, Bern, Kiel, Feidelberg, and finally, in 1877, to Leipzig, there becoming the successor of his former master, Ritschl. Ribbeck's works

are mostly confined to criticisms of Latin poetry and to classical character sketches and display a profound knowledge of the classics combined with a brilliant style of essay. Among them are: 'Vergelii Opera,' with prolegomena and critical notes (5 vols., 1859-69); 'Tragicorum Latinorum reliquiae' (1862); 'Cornicorum Latinorum reliquiae' (1855); 'Der echte und unechte Juvenal' (1865); 'Horace's Epistles' (1869); 'Zur Lehre von den Latein Partikeln' (1860); 'Die römische Tragödie im Zeitalter der Republik' (1875); Plautus's 'Miles Gloriosus' (1831); the biography of Friedrich Ritschl (2 vols., 1879-81); 'Geschichte der römischen Dichtung' (3 vols., 1889-92; 2d ed., 1897-1900); and the classical character sketches (which appeared in the *Rheinische Museum*, of which he became editor in 1876) 'Alazon' (1882), 'Kolax' (1885), and 'Agrochos' (1885).

Ribbed Vaulting. See GOTHIC ARCHITECTURE; VAULT.

Ribbon, a narrow web, generally of silk, used for tying and ornamental purposes. Ribbon-weaving is a special branch of the textile industries. In modern looms as many as 40 ribbons are simultaneously woven in one machine. Mixed fabrics of silk and cotton are now largely employed. See SILK AND SILK INDUSTRY.

Ribbon-fish. See DEEP-SEA LIFE.

Ribbon-snake, a garter snake (q.v.) of slender form and conspicuous stripes.

Rib'bonism, in Irish history, the name given a group of secret associations among the lower classes in Ireland throughout the half century extending from 1820-70, at its greatest height from about 1835 to 1855. Its origin and organization are alike wrapped in obscurity, but it appears in the beginning at least to have been political in its aims, and it seems probable that it grew out of the northern Defenders who banded themselves to oppose the Orange organization. Earlier associations with somewhat similar aims were the Whiteboys and the Threshers, and in particular corners of the island, the Carders, Shanavests, and Caravats. Though everywhere condemned by the Roman Catholic clergy, Ribbonism included none but Roman Catholics within its numbers, and it maintained its influence by a system of oaths and secret signs and passwords. One striking feature of Ribbonism, as distinguished from most Irish patriotic associations, was the fact that its adherents belonged exclusively to the very lowest and most ignorant classes, the humbler peasantry, farm servants, laborers, and petty shopkeepers, hardly even the smallest farmers or their sons apparently belonging to it in any part of Ireland. So far as there was any unity in its aims, it aimed at making itself a public conscience on all agrarian questions; but, the Ribbonism of one period and of one district was not the Ribbonism of another. In Ulster it professed to be a defensive or retaliatory league against Orangeism. In Munster it was at first a combination against tithe-proctors. In Connaught it was an organization against rack-renting and evictions. In Leinster it often was mere trade unionism. The name originated in a badge worn by the members.

Ribeiro, rê-bă'roo, **Bernardim**, Portuguese poet: b. Torrão, Alentejo, about 1486; d. about

1550. He appears to have been a gentleman of the chamber at the Portuguese court and to have been involved in an unhappy love affair with Donna Joana de Vilhena, a relative of the king. He was one of the first to introduce in Portuguese literature the Italian pastoral style which has since prevailed in Portugal. Of his writings there are still extant five idylls and several lyrics beside his best known work, the pastoral romance 'Menina e Moça' (1554). Editions of the 'Obras de Bernardim Ribeiro' were published in 1645, 1785, and 1852, and in 1891 an excellent edition of 'Menina e Moça' with a 'Prefacio' was edited by Dom Jose Pessanha.

Ribeiro-Ferreira, fār-rā'ê-rā, Thomaz Antonio, Portuguese poet: b. Parada de Gonta, Portugal, 1 July 1831; d. 1901. He was educated for the bar at Coimbra and in 1870 was appointed secretary-general of the Portuguese colonies. In 1878 was appointed colonial secretary, minister of the interior in 1881, and in 1885 and in 1890 was minister of public works. He was minister to Brazil in 1895-6. As a poet he attained high rank, his work exhibiting much grace and a fervid patriotism. His works include: 'Sons que passam' (1854); 'Vesperas' (1858); 'Don Jaime' (1861); 'Delírio do Mal' (1868); 'Dissonancias' (1890); etc.

Ribera, rē-bā'rā, José or Jusepe de (known as "Lo SPAGNOLETTO"), Spanish painter: b. Jativa, kingdom of Valencia, 12 Jan. 1588; d. Naples 1656. Although early entered at the University of Valencia, he preferred the studio of Francisco de Ribalta (q.v.) to the schools of book-learning. He eventually left Valencia for Naples, and thence took up his residence at Rome, where he was given the name of Lo Spagnoletto, "the Little Spaniard." Here he studied the works of Raphael and the Caracci. He also visited Parma and Modena and copied the paintings of Correggio. It is, however, very evident that while he was at Naples Cavaraggio exercised a preponderating influence over his style, and, though a Spaniard, he must be ranked as one of the most pronounced representatives of the Naturalistic School of Naples. Pedro de Madrazo calls him "a most excellent painter, who finds his place among the greatest Italian masters." Both in coloring, chiaroscuro and anatomical knowledge he excels many of the Neapolitan school; but he generally chose gloomy, austere or revolting subjects for his powerful brush, and these he treated with a wild and extravagant fancy which deepened the horror each incident inspired, such as his 'Prometheus Chained to the Rock'; 'The Torment of Sisyphus'; 'The Flaying of Saint Bartholomew'; 'Saint Sebastian Transfixed with Arrows' (all in the Prado Museum, Madrid); 'The Martyrdom of Saint Lawrence' (Dresden Gallery). His etchings, of which he has left 26, are mostly figure pictures of great spirit and power. He had a great number of pupils and imitators, among whom were Salvator Rosa and Lucio Giordano. Consult: 'Diccionario historico de las bellas artes' (1800); and 'Diccionario Enciclopedico Hispano-Americano' (1895).

Ribot, rē-bō, Alexandre Felix Joseph, French statesman: b. Saint Omer 7 Feb. 1842. He was educated at the Lycée of St. Omer and studied law in Paris where he was admitted to the bar in 1863. He entered public official life in

1870 and in 1878 entered the Chamber of Deputies for Boulogne-sur-Mer. He was minister of foreign affairs in the cabinet of de Freycinet, 1890-3, assisting in forming the alliance between France and Russia, concluded during that period. In January 1893 he was made president of the cabinet and held this office during the investigations of the Panama scandals; also again in 1895 after the election of Faure as president. He was superseded by Bourgeois in October of that year. His most important speeches have been on finance, foreign affairs, and freedom of education. In the latter cause he took a position opposing the recent persecution of the religious orders and published in 1900 a work entitled 'Reforme de l'Enseignement secondaire' embodying his observations as chairman of the committee appointed to make inquiry into the state of secondary education. He has also published 'Biographie de Lord Erskine' (1866); and 'Acte du 5 Août 1873 pour l'Etablissement d'une Cour suprême de Justice en Angleterre' (1874).

Ribot, Augustin Théodule, French painter: b. Breteuil (Eure) 8 Aug. 1823; d. Colombes 11 Sept. 1891. His only schooling in art was obtained by copying pictures in the Louvre. His early works were household and kitchen scenes; 'Cooks'; 'The Dinner Hour'; 'Interior of the Kitchen'; 'The Merry Cook,' and 'Poultry.' After 1865 he painted religious subjects; but chose to interpret them by selecting scenes of modern life which he gave with a startling realism, 'Jesus in the Temple'; 'Saint Sebastian' and 'The Good Samaritan,' now in the Luxembourg gallery are examples in this vein. In his early days he was forced to practise his art during the night hours, and this no doubt confirmed his predilection for concentrated light and strong shadows. In this he is allied to masters of the Dutch school, while in the frank realism of his methods he is classed with Velasquez and Ribera. In later life he painted historical and genre subjects in addition to his earlier field of subjects.

Ribot, Théodule Armand, French psychologist: b. Guingamp 18 Dec. 1839. He was educated at the Lycée de St. Briere and the Ecole Normal Supérieure, where he was graduated in 1866. He held the chair of philosophy at the lycée of Vesoul and at Laval, 1866-71, when he went to Paris and devoted himself exclusively to researches in experimental psychology in histological and physiological laboratories and in the insane hospitals. In 1876 he founded the 'Revue Philosophique,' and in 1885 began his courses at the Sorbonne. Since 1888 he has been professor of experimental and comparative psychology in the College of France. In his first work, 'La Psychologie anglaise contemporaine' (1870), he initiated a new school of psychological research in France. The method employed in this work he has consistently followed in succeeding ones. Ignoring all non-material elements in mental life, he seeks his results in the observation and measurement of nervous phenomena in the individual; and the comparison of observed psychological phenomena in races, in infants and in animals. His other works are 'Psychologie allemande contemporaine' (1879); 'Les Maladies de la Mémoire' (1881); 'Les Maladies de la Volonté' (1883);

'Les Maladies de la Personnalité' (1885); 'La Psychologie de l'Attention' (1889); 'L'Hérédité psychologique' (1893); 'Psychologie des Sentiments' (1896); 'L'Evolution des Idées générales' (1897).

Ribs. See ANATOMY; OSTEOLOGY; THORAX.

Ricardo, rī-kār'dō, **David**, English political economist: b. London 19 April 1772; d. Gatcombe Park, Gloucestershire 11 Sept. 1823. His father was a prosperous Jew, born in Holland, but settled in England since his youth, and a member of the stock exchange. The son was educated in England and later in Holland, but had no university training and entered his father's business at 14. He married early and conformed to the Christian religion, whereupon an alienation with his father necessitated his taking up business on his own account. In this he was immediately successful and made a fortune on the stock exchange, at the same time preserving an honorable reputation. In 1799 he became interested in Adam Smith's 'Wealth of Nations' and turned his attention to the scientific treatment of questions connected with banking and finance. His first contributions to the subject appeared as letters in the *Morning Chronicle* in 1809 and later appeared in a pamphlet entitled 'The High Price of Bullion a Proof of the Depreciation of Bank-notes.' The report of the bullion committee in 1810 coincided with the principles of Ricardo in its attributing the depreciation of the currency to excessive issues of the Bank of England and in recommending a resumption of cash payments. In 1816 Ricardo proposed a scheme for making bank-notes exchangeable for standard bars of gold bullion instead of coined gold. The scheme was adopted in 1819, but had to be abandoned on account of the temptation to forgery. In 1817 appeared his principal work, 'On the Principles of Political Economy and Taxation.' This work instead of being a historical or philosophical treatment of the general theme is rather a specialized examination of such factors as value, rent, wages, etc., and his contributions to these subjects, while not absolutely original, yet were for the first time stated with fulness and authority. His writings have had a profound influence upon modern doctrines, though his views are not now fully accepted. James Mill and J. R. McCulloch were his disciples. He retired from business in 1814, and in 1819 entered Parliament for the Irish borough of Portarlington. He held the seat until his death and contributed to important discussions of financial questions. Consult 'Life' by McCulloch (1846).

Ricasoli, rē-kā'sō-lē, **BARON Bettino**, Italian statesman: b. Florence 9 March 1809; d. near Siena 23 Oct. 1880. He first entered public life in 1847 when he submitted to the Grand Duke Leopold of Tuscany, plans of governmental reform which the latter saw himself forced to adopt. Ricasoli became mayor of Florence in 1847 and in the following year was elected to the Tuscan parliament, and helped to bring about the recall of the grand duke. After the battle of Novara (1849) and the restoration of Austrian influence he retired to private life and devoted himself mainly to the scientific study and practice of agriculture. When the revolutionary movement of 1859 compelled the

grand duke to flee, Ricasoli became minister of the interior and in August of the same year, dictator. He resolutely opposed all attempts at a restoration of the grand-ducal government and labored for the annexation of Tuscany to Sardinia, which was accomplished in March 1860. He was made, thereupon, governor of Tuscany and was a member of the first Italian parliament which assembled in 1861. In June he succeeded Cavour as head of the ministry and sought to carry out his predecessor's policy, but he could make no head against the opposition and in March 1862, made way for the ministry of Rattazzi (q.v.). He assumed office once more in the early part of 1866, conducted public affairs with ability during the war against Austria, but met with no success in his internal policy of decentralization and financial reform because of his inability to rally a parliamentary majority to his support. He resigned in April 1867, to be followed by Rattazzi, but remained a member of the chamber of deputies till his death, though taking no very active part in affairs. His 'Letters and Papers' were published by Tabarrini and Gotti at Florence in 10 volumes (1886-1894).

Ricciardelli, rēt-chār-dē'lē, **Daniele**. See VOLTERRA, DANIELE DA.

Riccio, rēt'chō, or **Rizzio**, rēt'sē-ō, **David**, Italian secretary to Mary Queen of Scots: b. Pancalieri about 1533; d. Edinburgh, Scotland, 9 March 1566. He was educated as a musician, and in 1561 went to Scotland in the train of the Marquis of Moretto, ambassador of the duke of Savoy. At first a singer in Queen Mary's private chapel, in 1564 succeeded Raulet as the queen's secretary. The causes of his elevation have been variously explained. Coincident with the event was Mary's determination to act in matters of state independently of the Scottish nobles or even of her uncle of Lorraine, and the supposition is natural that in Riccio Mary found a safer confidant than in her former French secretary. After the queen's marriage to Darnley in July 1565, Riccio rose even higher in the favor of Mary, and it was Mary's avowed intention to make him her prime minister. His intimacy with the queen aroused the jealousy of Darnley and his haughty behavior made enemies of the nobles. The conspiracy formed to remove the objectionable secretary was precipitated into action by Mary's refusal to pardon Moray and other exiles in England. Its leaders were the relatives of Darnley, Lord Maitland who had fallen from power, and leading Protestants including probably John Knox; with the English government standing as a neutral abettor. Riccio was dragged from the queen's supper-chamber in Holyrood palace and despatched with at least 56 wounds.

Rice, **Alice Hegan**, American humorous writer: b. Shelbyville, Ky., 11 Jan. 1870. She was educated at Hampton College, Louisville, Ky., and was married to C. Y. Rice, of Louisville, in 1902. Her first book, 'Mrs. Wiggs of the Cabbage Patch' (1901), attained extraordinary popularity, and was followed by 'Lovey Mary' (1903); 'Sandy' (1904).

Rice, **Allen Thorndike**, American editor: b. Boston, Mass., 18 June 1853; d. New York 16 May 1889. He was graduated from Oxford in 1875 and in 1876 purchased the 'North Amer-

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ican Review' of which he became editor. He was one of the promoters of the Charnay expedition which in 1879 investigated the ruins of primitive civilization in Central America and Mexico. He was actively interested in politics, an earnest advocate of a more efficient copyright law, and was chiefly instrumental in securing the introduction of the Australian ballot system into the United States. In 1889 he was appointed minister to Russia, but died before the date set for sailing. He edited 'Reminiscences of Abraham Lincoln' (1886) and contributed to 'Ancient Cities of the New World' (1887).

Rice, Edmund, American military officer: b. Cambridge, Mass., 1842; d. Wakefield, Mass., 20 July 1906. He entered the Union army in 1861, received rank as captain, was voted a medal of honor by Congress for bravery at Gettysburg, and was mustered out with rank as colonel in 1865. He entered the regular army in 1866, was promoted colonel and in 1877 served for a time on the staff of General Skobelev in the Turko-Russian war. He was appointed inspector-general in 1898, and in 1902-3 was colonel of the 19th Infantry. He was retired in 1903. The trowel bayonet, stacking swivel, and knife-intrenching bayonet now in use in the United States army were his inventions.

Rice, Isaac Leopold, American lawyer: b. Wachenheim, Bavaria, 22 Feb. 1850. Coming to Philadelphia with his parents in 1856, he was educated at the Boys' Central High School of that city, and showing a genius for music was sent to Paris to complete his musical training. In 1868 he visited England and taught there music and the languages for a year when he settled in New York, teaching music for a time and then entering Columbia Law School, from which he graduated in 1880, taking prizes in constitutional and international law. He founded the School of Political Science and was lecturer (1882-3), and subsequently instructor in the Columbia Law School (1884-6). He is a specialist in railroad law and was counsel and director in the lines now constituting the Southern Railroad, and for a time foreign representative of the Philadelphia & Reading Railway. He has taken an active part in the application of electricity to transportation and is prominently identified with many financial interests. He founded 'The Forum' in 1885 and is a leader in international chess. He has published 'What is Music?' (1875), and has written many articles in leading reviews.

Rice, James, English novelist: b. Northampton 26 Sept. 1843; d. Redhill, Surrey, 26 April 1882. He studied at Queen's College, Cambridge, without taking a degree, and in 1868 became editor and proprietor of 'Once a Week.' He was called to the bar in 1871 and while waiting for clients he became London correspondent for the *Toronto Globe*. His first literary success was with the novel, 'Ready Money Mortiboy' (1872), written conjointly with Walter Besant. The novel was dramatized and produced at the Court Theatre in March 1874. Other novels written in partnership with Besant were 'With Harp and Crown' (1874); 'The Son of Vulcan' (1875); 'The Golden Butterfly' (1876); 'The Monks of Thelema'

(1877); 'By Celia's Arbour' (1878); 'The Chaplain of the Fleet' (1879); 'The Seamy Side' (1881). Rice wrote also a 'History of the British Turf' (1879).

Rice, Wallace (de Groot Cecil), American literary critic: b. Hamilton, Ontario, 10 Nov. 1859. He was graduated from Harvard in 1883 and admitted to the Chicago bar in 1884. He has served as reporter and critic on various Chicago papers, and has published 'Under the Stars and Other Songs of the Sea' with B. Eastman (1898); 'Heroic Deeds' (1898); 'Flying Sands' (1898); 'Wild Animals' (1901); etc.

Rice, William Morton Jackson, American painter: b. Brooklyn 18 Feb. 1854. He graduated at Cornell University in 1874 and studied art under Carroll Beckwith in New York, afterward at Paris under Carolus-Duran. In 1886 he became a member of the Society of American Artists and in 1900 an associate of the National Academy of Design. He was awarded a bronze medal at the Pan-American Exposition, 1901.

Rice, William North, American educator: b. Marblehead, Mass., 21 Nov. 1845. He was graduated from Wesleyan University in 1865, and was professor of geology and natural history there 1867-84; and of geology after 1884. He was assistant geologist of the United States Geological Survey 1891-2, and president of the American Society of Naturalists in 1891. He has published 'Geology of Bermuda' (1884); 'Science Teaching in the Schools' (1889); 'Twenty-five Years of Scientific Progress and Other Essays' (1894); and an edition of Dana's 'Text-book of Geology' (1897).

Rice, Wild or Indian. See GRASSES IN THE UNITED STATES.

Rice-bird, in the United States the bobolink (q.v.), so called in the South Atlantic, where it is a serious pest in the late autumn to the rice crop; in the East Indies, a familiar and handsome finch-like weaver-bird (*Munia oryzivora*), also known as the Java sparrow and paddy bird. It possesses a large pinkish bill; the head and tail are black, the belly rosy, the cheeks of the male white, and the legs flesh-colored. It is dreaded in southern Asia on account of the ravages it commits in the rice fields, but is frequently brought to Europe and America as a cage-bird.

Rice Industry, American, The. The rice industry had its inception in America about the middle of the 17th century, when Sir William Berkeley made an attempt to raise rice in Virginia in 1647. As this experiment, which was continued for several years, was an utter failure, owing probably to the high latitude in which the seed was planted, it was generally believed that such a crop could not be grown in this country. The fact that this was an error was discovered accidentally, in 1694, when a vessel bound for Liverpool from Madagascar, was blown so far out of her course that, having been somewhat injured by the storm, it was decided to put into Charleston for repairs. Among those who boarded the vessel was Landgrave Thomas Smith, and, at his request, the captain gave him a small package of rough rice to be used as seed. Although little faith was expressed in the success of the experiment

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Smith planted it in proper soil in lower Carolina, and his enterprise was rewarded by the growth of a crop that was almost sufficient to meet the needs of the entire colony.

From that day the success of the rice industry was assured. By 1707, the cultivation of rice had extended so widely that no less than 17 ships sailed from Carolina with cargoes of this grain, and, during the 10 years between 1730 and 1739, inclusive, the shipments to Great Britain and other ports amounted to more than 223,787,000 pounds. In 1754, the exports to England alone aggregated over 100,000 barrels of unhusked rice, which was equivalent to 30,000,000 pounds of the cleaned product, and yet the supply that was left was ample for home consumption. From that time until 1784, the yield remained practically the same, but, in that year, the system of water culture was introduced, an innovation which has since resulted in constantly increasing crops.

The following statistical table gives a clear idea of the condition of the industry from the beginning of the 19th century up to 1900, together with necessary information regarding the prevailing tariffs. For the sake of brevity these figures have been grouped in periods of five years, with annual averages. The table is as follows:

PRODUCTION OF RICE IN THE UNITED STATES FOR 105 YEARS, 1795 TO 1900, WITH TARIFF RATES PREVAILING FROM 1789 TO 1857.

Five years ending June 30	Production for five years (Pounds)	Average per year	Tariff on Rice	
			Year enacted	Rate ad valorem
1800.....	320,631,803	64,124,361	1789	5 per cent
1805.....	240,044,600	48,008,920	1792	7½ "
1810.....	274,477,000	54,895,400	1794	10 "
1815.....	274,867,800	54,973,560	1800	12½ "
1820.....	282,397,800	56,479,560	1804	15 "
1825.....	331,447,000	66,289,400	1812	30 "
1830.....	417,333,600	83,466,720	1818	15 "
1835.....	457,282,200	91,456,440	1832	Free
1840.....	420,585,600	84,117,120	1835	15 per cent
1845.....	481,660,200	96,332,040	1841	20 "
1850.....	511,404,400	102,280,880	1857	15 "
1855.....	483,279,600	96,655,920		
1860.....	541,502,600	108,300,520		
1865.....	115,718,800	23,143,760		
1870.....	160,817,700	32,163,540		
1875.....	276,704,430	55,340,886		
1880.....	415,332,000	83,066,400		
1885.....	534,720,400	106,944,080		
1890.....	675,950,400	135,190,080		
1895.....	762,608,460	152,521,692		
1900.....	713,142,520	142,628,504		

The average per year as given under 1900 is much below the great yield of 1890, 250,280,227 pounds, or that of the following year, 285,750,000 pounds.

DUTY FROM 1861 TO 1897.

Specific duty	Cleaned per pound	Uncleaned per pound	Paddy per pound	Flour granulated	Ad valorem equivalent
1861.....	Cts. 1	Cts. ½			41 per cent
1862.....	1½	1	¾		48 "
1864.....	2½	2	1½		94 "
1876.....	Hawaiian Rice				Free
1883.....	2½	1½	1½	ad val. 20% specific	110 per cent
1890.....	2	1½	¾	¾	99 "
1894.....	1½	8-10	¾	¾	88 "
1897.....	2	1½	¾	¾	80 "

Although the superiority of American rice was a well-established fact long before the Civil War the success that planters have attained since 1865 has been indicated in a better quality of rice. In the old days, before the war, when Ward's famous "long grain Carolina" rice was the standard of perfection, Georgia and the Carolinas were the only States in which rice was grown to any great extent. In nearly all the other southern States its cultivation was merely for home consumption. Since the war, however, there has been a change in these conditions: Georgia and the Carolinas have retained their rice fields, but other southern States have evinced an increased interest in the cultivation of this product, Louisiana and Texas being particularly notable examples of the gigantic strides which this industry has taken.

The southern rice fields upon which the best commercial crops are grown are the reclaimed cypress swamps and the tide-water lands along the coast. Of course, many of the finest plantations are among the marshes higher up the rivers, or even in the interior upon level tracts that are so situated that they may be irrigated with ease. In nearly all of these plantations the system of water cultivation is followed. In the case of the tide-water lands, they lie along the rivers, above the meeting of fresh and salt water, in such a position that they may be flooded with water when the tide is high and drained at low tide. Thoroughly protected by dikes, the salt water, which is so fatal to the rice, cannot reach them from below, nor can freshets sweep them from above.

The serious check which this industry had received during the war was not forgotten immediately upon the declaration of peace. Lands there were in plenty, but there was no money to operate them, and it was not until incidental protection was derived from the tariff that any vigorous attempt was made to rehabilitate the old plantations. Since that time the greatest advancement has been made in Louisiana, and, during more recent years, in Texas.

The history of rice culture in Louisiana dates back to 1718, but, during all the years prior to the war, this industry was confined chiefly to the parish of Plaquemine. Experience had shown, however, that, in Louisiana, rice was a sure crop, upon which a fair price could be realized quickly without the outlay of a great amount of money, and so, in the uncertain days that followed 1864, it was to rice that the planters turned, with the result that a crop which had never been able to do more than supply a local demand, suddenly sprang into a position of national importance. So great and lasting was this impetus that, by 1875, the State of Louisiana was furnishing fully 30 per cent. of the total yield of the United States, while in each of the five years following 1880, it averaged 40 per cent.; 1885, 60 per cent.; 1890, 65 per cent.; 1895, 75 per cent., and in 1900, no less than 80 per cent. of the aggregate production of the country. In fact, the rice industry in Louisiana has developed to such a marvelous extent during the past 30 years that a statistical illustration of its progress is as important as it is interesting. Given in five-year periods, this is shown on the following page.

The stride that is shown in 1885 is largely due to the opening of an entirely new area to

RICE LAKE—RICH MOUNTAIN

PRODUCTION OF RICE IN LOUISIANA.

Five years ending June 30	Pounds	Average per year
1865.....	9,667,080	1,933,416
1870.....	35,268,590	7,053,718
1875.....	81,756,030	16,351,206
1880.....	176,604,000	35,338,800
1885.....	255,516,200	51,103,240
1890.....	422,775,000	84,555,000
1895.....	555,595,400	111,119,080
1900.....	547,104,000	109,420,800

Prior to the war, the annual product was about 1,000,000 pounds.

the cultivation of this product. This portion of the State, which was known as the "Calcasieu Country" section, extended from the Atchafalaya River on the east to the Sabine River on the west.

It was the opening of this southwestern section of Louisiana that tended to call attention to Texas as a possible rice-producing State. There were good lands in plenty. All that was required was the experiment, for when it was made the result was so highly satisfactory that, although there was practically little rice grown in Texas prior to 1900, the report of the next five-year period will show such a complete change in the situation that Louisiana will no longer be able to boast of having raised such an enormous percentage of the aggregate yield, and as both southwest Louisiana and Texas offer a most promising field to investors who are able to develop the lands under the canal system of irrigation there is little reason to believe that either of these sections of the country have commenced to show what marvels they can perform as the great rice-growing centres of the Union.

Rice Lake, Wis., city, in Barro County; on the Red Cedar River, and on the Chicago, Milwaukee & Saint Paul railroad; about 45 miles north by west of Eau Claire. It is in a lumber region and the chief industries are connected with farm and lumber products. It has public and parish schools, a public library and private business schools. Pop. (est.) 3,100.

Rice Paper, also called **Pith Paper,** and more properly, as the substance is not derived from rice. The product of a small tree, 10 to 15 feet high, known botanically as *Aralia (Fatsia) papyrifera*, which grows in many portions of Formosa. Japanese name, Tsuso; Chinese name, Tung Tsao. The pith is extracted by breaking the bark and outer woody portion, and forcing out the cylindrical core. Consul Jas. W. Davidson states that the paper is produced by skilfully paring these cylinders of pith with a sharp knife as they are rolled upon the surface of a tile or other hard substance that will serve as a bed plate, the thickness of the sheet of pith paper being regulated by the angle at which the knife is held. The sheets are put under heavy pressure for a time, and are finally cut into squares of 3½ inches, and packed 90 in a package. There are three grades of the paper, which is chiefly used for the manufacture of artificial flowers, and also for the painting of small fancy pictures, and to some extent for sun hats. Tamsui is the port of shipment, and as high as 28,000 pounds have

been exported in a single year, worth over 15,300 yen. See also PAPER.

CHARLES RICHARDS DODGE.

Rich, Edmund. See EDMUND, SAINT.

Rich Hill, Mo., city in Bates County; on the Osage River; and on the Kansas City, F. S. & M., and the Missouri Pacific R.R.'s; about 83 miles south of Kansas City. It is in an agricultural and coal region; in the vicinity of the largest coal fields in Missouri. Its chief industries are connected with the mining and shipping of coal. It has vitrified brick works, canning factories, a foundry, distillery, machine shops, and zinc smelters. It has an extensive trade in coal, farm products, canned goods, and brick. The principal public buildings are the churches and schools. Pop. (1890) 4,008; (1900) 4,053; (1910) 4,180.

Rich Mountain, Battle of. After the reverse of Col. Porterfield at Philippi (see PHILIPPI, ENGAGEMENT AT) Gen. Lee ordered Gen. H. A. Wise to the Kanawha Valley and Gen. R. S. Garnett to the Cheat Mountain region. Garnett was to relieve Porterfield, recover lost ground, and secure control of the Baltimore and Ohio Railroad. With one regiment he arrived at Huttonsville on 14 June, where he found Porterfield with about 1,400 men. Leaving Porterfield at Huttonsville with three companies to guard his line of communication with Staunton, Garnett marched on the night of the 15th to Beverly, from which point a regiment, a company of cavalry, and two guns were sent by the Parkersburg road to the west foot of Rich Mountain, seven miles west of Beverly. Garnett, with the other regiment, two guns, and a company of cavalry pushing on to Laurel Hill, the northern extension of Rich Mountain, 17 miles northwest of Beverly. These positions were regarded as the gates to northwestern Virginia, and both were strongly fortified. By 1 July Garnett had nearly 4,000 men, including his reserve at Beverly and Huttonsville.

Gen. McClellan arrived at Grafton 23 June, and prepared to expel the Confederates from their positions and to enter the Shenandoah Valley. He had 20,000 men; 5,000 along the line of the Baltimore and Ohio Railroad; a brigade of over 3,000 and a battery, under Gen. T. A. Morris, were stationed at Philippi; and by 2 July the main column, under his own immediate command, was concentrated at Buckhannon, 24 miles west of Beverly. This column of over 10,000 men, with 12 guns, was organized into three brigades, under Gens. W. S. Rosecrans and N. Schleich, and Col. R. L. McCook. On 2 July Gen. J. D. Cox was ordered to cross the Ohio with a brigade, and co-operate with McClellan by moving up the Kanawha Valley against Gen. Wise. On 6 July Morris was ordered to march his brigade from Philippi to within a mile and a half of Garnett's position at Laurel Hill, and on the 9th McClellan had the three brigades of his own column at Roaring Creek, two miles from the west foot of Rich Mountain, where Lieut. Col. John Pegram was intrenched, with 1,300 men and four guns. Preparations were made to assault Pegram in front with Rosecrans' brigade, on the morning of the 11th, but on the evening of the 10th Rosecrans learned that Pegram's rear could be reached by a difficult route around his left, and proposed to

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do it with his brigade. To this McClellan assented. It was arranged that Rosecrans should march at daybreak of the 11th, with about 1,900 men, gain the road in Pegram's rear, march down it and attack, and that at the sound of the engagement in rear McClellan would attack in front. Rosecrans, after a very hard march, made the turning movement, and coming to the road about 3 P.M., unexpectedly came under fire of musketry and artillery and was checked. Pegram had been warned of danger to his rear, and during the morning had sent two detachments to Hart's farm, at the summit of the mountain, with Maj. J. A. De Lagnel in command, who took with him a gun of his battery, and threw up breastworks for his 310 men. Rosecrans attacked, was at first repulsed, and it was not until after a sharp engagement of nearly two hours that he succeeded in driving the Confederates from position, just as Pegram was approaching with reinforcements and another gun. A part of the reinforcements became involved in the defeat, and Rosecrans captured the two guns. Nothing had been heard from McClellan, and knowing that a considerable body of Confederates was still near him, Rosecrans directed his men to lie on their arms until morning. Rosecrans lost 12 killed and 49 wounded. The Confederates had made a gallant fight, with a loss of 40 to 45 killed and about 25 wounded. The noise of the engagement had been heard in McClellan's ranks, and he prepared for an attack in front, but the long continuance of the artillery-fire on the mountain, and some cheering in Pegram's camp, impressed him that it had gone badly with Rosecrans, and the attack was not made, and near night he withdrew his troops beyond Roaring Creek. At daybreak of the 12th Rosecrans found that the Confederates had disappeared and, marching down the mountain, he entered Pegram's abandoned camp, taking two more guns, with some sick and wounded, and as nothing was seen of McClellan, he sent him word of what he had been doing and where he was.

The forces engaged with Rosecrans on the mountain top succeeded in passing around his right during the night to Beverly, where they were joined by the 44th Virginia, and the retreat was continued through Huttonsville and across Cheat Mountain to Greenbrier River, and then to Monterey. Pegram abandoned his works, intending to follow his detachment to Beverly, but in the darkness his column was broken up, part reaching that place. Pegram led the remainder to join Garnett, marching all day of the 12th, and halting at night in the valley six miles north of Beverly. There, hearing that Garnett had retreated northward, and that McClellan was at Beverly, and seeing no chance of escape, he sent to McClellan an offer of surrender. This was accepted, and next morning Pegram surrendered 30 officers and nearly 500 men. Garnett, at Laurel Hill, informed of the disaster that had befallen Pegram on the 11th, abandoned his works after dark, and retreated toward Beverly. When within five miles of the place, at daybreak of the 12th, he received erroneous information that McClellan had already occupied it, whereupon he retraced his steps and retreated north toward Saint George and West Union, hoping to escape by the Northwestern Turnpike, but was over-

taken by Morris at the fords of Cheat River, at noon of the 13th, and killed in a rearguard fight at Corrick's Ford. His army continued the retreat through Red House, Greenland, and Petersburg to Monterey. McClellan occupied Beverly on the 12th and Huttonsville on the 14th, and pushed his advance to the summit of Cheat Mountain. Leaving a force on Cheat Mountain and at Huttonsville he returned to Beverly on the 16th. A few days later McClellan was called to Washington and assigned to the command of the troops for the defense of the city. On 1 November he became commander of the Army of the United States. His short and successful campaign, with that of Gen. Cox up the Kanawha Valley, settled the fate of West Virginia, stimulated the Union men in their effort to form a new government, and finally resulted in the dismemberment of Virginia and the formation of the new State of West Virginia. Consult: 'Official Records,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. I.

E. A. CARMAN.

Richard I., king of England: b. Oxford 8 Sept. 1157; d. Chaluz, France, 6 April 1199. He was the 3d son of Henry II. of England and Eleanor of Aquitaine and while an infant was betrothed to Alice, a daughter of Louis VII. of France. Made duke of Aquitaine in boyhood, he took part in the rebellion of his brothers against his father, who at different times attempted to deprive Richard of his possessions, and even planned to exclude him from the succession to the crown in favor of the younger son John. In 1189, in conjunction with Philip Augustus of France, he waged war on his father and compelled Henry II. to acknowledge his right to the throne. Two days after the conclusion of peace Henry II. died at Chinon (6 July 1189). In September, he was crowned king at Westminster and immediately began preparations for a crusade to the Holy Land, in fulfilment of a vow made two years before. To raise money for the expedition he sold fiefs and offices, surrendered to William the Lion of Scotland the suzerainty over that country and increased the burden of taxation. Proceeding through France he joined the army of the French king at Messina where he became involved in a conflict with Tancred, king of Sicily, in the course of which the English king made himself master of Messina. The intrigues of Philip Augustus brought on enmity between the two sovereigns and Richard repudiating his betrothed, Alice, sister of the French king, secured the hand of Berengaria of Navarre, who joined him at Cyprus where they were married. After he had conquered the island and seized its treasures he joined the crusading army before Acre (8 June 1190). Between the English and the French bitter feelings now prevailed and at one time hostilities were threatened. Acre, nevertheless, was taken by the crusaders, and in August Philip sailed for Europe. War with Saladin (q.v.) was renewed on account of Richard's atrocious massacre of 2,700 Mohammedan prisoners. At Arsuf, 7 September, Richard won a decisive victory and in spite of prolonged negotiations moved on Jerusalem, arriving in December 1191 within a very short distance of the city. He fell back to Ascalon where the contest between

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Guy of Lusignan and Conrad of Monferrat for the kingdom of Jerusalem was productive of dissensions among the crusaders. A second advance on Jerusalem met with ill success and in August 1192, Richard concluded a three years' truce with Saladin and left the Holy Land, having made no conquest beyond that of Acre. Shipwrecked in the Adriatic, he attempted to make his way disguised through Germany, but was taken prisoner near Vienna by his enemy, the Duke of Austria, who handed him over to the Emperor. Brought before the imperial diet, Richard pledged himself to a ransom of 150,000 marks and received his English kingdom as a fief from the Emperor. The influence of the French king and Richard's own brother was effectual in prolonging the English king's imprisonment. Liberated in March 1194 he landed in England in the same month and was crowned a second time. John was forced to submit and Richard, collecting all the money he could for a war with Philip of France, sailed for Normandy in May. The contest which dragged on for five years presents little that is noteworthy, and in January 1199 peace was made. While besieging the castle of Chaluz, held by a vassal with whom Richard disputed the possession of a newly found treasure, the king was wounded by an arrow and died in his tent. Richard I. owes his fame to the glamor with which legend has surrounded his name as the typical warrior of the Middle Ages. As a king he did nothing for England; his great passion was war, and the only redeeming features in a character of violence and ferocity are a certain naive magnanimity and the splendid courage which gained him even in his lifetime the title of *Cœur de Lion*, "Lion-hearted." The legend which recounts how Richard immured in an Austrian prison was discovered by his favorite minstrel, Blondel, who had wandered throughout Europe singing his songs outside of castle walls, dates from the second half of the 13th century. Richard figures prominently in Scott's 'Ivanhoe' (1820); and 'The Talisman' (1825), and in Maurice Hewlett's 'Richard Yea and Nay.' Consult Stubbs, 'Early Plantagenets' (5th ed. 1886); Norgate, 'History of the Angevin Kings' (1887); Archer, 'Crusade of Richard I.' (1889); Round, 'Feudal England' (1895); Stubbs, 'Constitutional History of England,' Vol. I. (6th ed. 1897).

Richard II., king of England: b. Bordeaux 6 Jan. 1367; d. Pontefract, Yorkshire, February 1400. He was a younger son of the Black Prince and a grandson of Edward III. and succeeded to the throne on the death of his grandfather in June 1377, at a time when England was suffering from the effects of the black death, the demoralizing results of the war with France and the misgovernment by faction that marked the latter part of the reign of Edward III. The young king was placed under the control of a council in which his uncle, John of Gaunt, Duke of Lancaster, exercised a predominant and, on the whole, pernicious influence. Popular disaffection, fed by the ill success of the government in repelling attacks on the part of the French and the Scots, was intensified by the increasing burden of taxation. The imposition of a new capital tax in 1380 led to the

outbreak of the celebrated Peasants' Revolt in 1381. (See TYLER INSURRECTION.) Richard displayed great presence of mind in dealing with the insurgent forces near London, and to his bearing was largely due the speedy suppression of the revolt, which was directed largely against John of Gaunt. In 1382 he married Anne of Bohemia and about the same time sought to free himself from the control of Parliament by building up a party of his own with Robert de Vere, Earl of Oxford, and Michael de la Pole, Earl of Suffolk, as a nucleus. Richard thereby came into conflict with John of Gaunt who in 1386 departed for France. The leadership of the opposition fell to the unscrupulous Duke of Gloucester, the youngest of the king's uncles. In 1387 Parliament, controlled by Gloucester, demanded the dismissal of the chancellor de la Pole, and of Oxford, who had been made Marquis of Dublin with sovereign rights in Ireland, and though the king refused to yield, he was compelled to accept a committee of 11 appointed by Parliament with extensive power of government for a period of one year. Suffolk was dismissed. When Richard set himself to overthrow the committee, the Duke of Gloucester and the earls of Arundel, Derby, Nottingham and Warwick, took up arms, marched on London, demanded the trial of five of the king's principal advisers on the charge of treason, and brought about their condemnation by Parliament. Forced to submit for a time, Richard succeeded in throwing off his uncle's authority in 1389 and for the ensuing eight years ruled with moderation and in peace. He had not abandoned, however, his views on the absolute authority of kings and had not forgiven the party of Gloucester for their persecution of his former supporters. In 1387 Gloucester, Arundel and Warwick were seized, and a packed and intimidated Parliament condemned the three to death. Arundel was executed, and Warwick imprisoned. Before sentence could be carried out on Gloucester, news of his death came; that death was probably a violent one. The earls of Derby and Nottingham were spared and raised to the dignities of Duke of Hereford and of Norfolk. Extensive powers were surrendered by Parliament to the king and his triumph was complete. A quarrel between Hereford and Norfolk led to their banishment from England in 1388 and on the death of Hereford's father, John of Gaunt, Richard seized the Lancastrian estates. In May he went to Ireland for the settlement of the affairs of that country and Hereford seized the opportunity of invading England, ostensibly for the purpose of recovering his estates. When Richard landed in England in August, he found himself abandoned by his followers and Henry of Lancaster in possession of power. On 19 August he gave himself up to Henry at Flint in Wales. He was brought to London and on 29 September resigned the crown in favor of Henry, who on the following day, took the royal title with the consent of Parliament. Richard was sentenced to strict imprisonment and was removed to Henry's castle of Pontefract. There he died, probably by violence, though his body was publicly exposed to refute the charge. Richard was a patron of Chaucer and Gower and was favorably inclined to the teachings of Wyclif. Consult Wallon, 'Richard II.' (1864); Stubbs,

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'Constitutional History of England,' Vol. II. (4th ed. 1896).

Richard II., a historical play by Shakespeare, produced between 1594 and 1596. It is based on Holinshed's 'Chronicle' and narrates the story of the supplanting, on the throne of England, of the weak-willed Richard II., by the politic Bolingbroke (Henry IV.). It is the earliest in point of time of the historical dramas and in 1720 an adaptation of it was made by Theobald. It is now and then seen upon the stage but much less often than 'Richard III.,' 'King John' or 'Henry IV.'

Richard III., king of England: b. Fothering Castle in Northamptonshire, 2 Oct. 1452; d. Bosworth, Leicestershire, 22 Aug. 1485. He was the youngest son of Richard, Duke of York, and upon the accession of his brother to the throne as Edward IV. he was created Duke of Gloucester and received the grant of extensive lands with the office of admiral. With Edward he fled to Holland in 1470, and with him returned in the following year, commanding the Yorkist vanguard against the Lancastrian forces at Barnet and Tewkesbury, where he distinguished himself by his courage and skill. There, too, he gave signs of his innate ferocity, by his execution of the Lancastrian commander Somerset and others. The murders of Edward, Prince of Wales, after Tewkesbury, and that of Henry VI. in the Tower are also ascribed to him. Richard became grand-chamberlain of England, and, marrying Anne, the younger daughter of Warwick, fell into violent disputes with his brother Clarence who was the husband of an elder daughter. The death of Clarence in 1478, for which Gloucester cannot be made directly responsible, greatly enriched the latter. In 1480 he became lieutenant-general of the north and in 1482 carried on a victorious campaign in Scotland. Edward IV. died in April 1483 leaving Richard as guardian of his 13-year-old son Edward and protector of the kingdom. Richard's first move after securing possession of the king was to seize the queen-mother's relatives, who were soon after sent to execution. Lord Hastings, who at first sided with Richard but showed signs of disaffection at his ambitious schemes, was likewise put out of the way. With the aid of the Duke of Buckingham Richard began openly to work for the crown. Doubts were cast on the legitimacy of Edward IV.'s children and in June a subservient Parliament asked Richard to assume the crown. This he did 26 June, though the coronation did not take place till 6 July. Soon after the young sons of Edward IV. were done to death in prison. Buckingham now began to plot against Richard and in October stirred up an insurrection in Wales and the southern counties, but the movement collapsed and Buckingham was sent to the scaffold (2 Nov. 1483). More than a year of peace followed during which Richard acquired much popularity by his wise legislative measures and energetic administration. Early in August 1485, Henry, Earl of Richmond, Lancastrian claimant for the throne, landed in England, and Richard going to meet him was defeated and slain at Bosworth Field, after a display of heroic valor. The popular conception of him as a dwarf and hunchback rests on no good authority. Undeniably he was a man of fine

powers and bid fair to become one of England's ablest rulers; undeniable, too, however, are his ruthless ferocity and total lack of moral consciousness. Consult: 'Letters and Papers of the Reigns of Richard III. and Henry VI.,' edited by Gairdner (Rolls Series 1861-3); Fabyan, 'The New Chronicles of England and France' (1811); Walpole, 'Historic Doubts on the Life and Reign of Richard III.' (1768); Legge, 'The Unpopular King: Life of Richard III.' (1835); Jesse, 'Memoirs of Richard III.' (1862); English Historical Review, Vol. V. (1891); Gairdner, 'Life and Reign of Richard III.' (1898).

Richard III., a historical drama by Shakespeare, the last of a closely linked group of historical tragedies. It was printed anonymously in 1599, but in the next year it appeared with Shakespeare's name. For nearly two centuries, or from 1700 to 1876, Cibber's alteration of the text was the only version seen upon the stage, but in the last named year Edwin Booth restored the Shakespearian version. By some authorities the play is supposed to have been a completion and alteration by Shakespeare of an earlier play by Marlowe on the same subject. It is still a popular play on the boards.

Richard Plantagenet, plān-tāj'ě-nět, EARL OF CORNWALL, titular emperor of Germany, younger son of King John of England: b. Winchester, Hampshire, 5 Jan. 1209; d. Kirkham, Lancashire, 2 April 1272. He fought against France, in the army of his brother Henry III., went on a crusade to Palestine, and on his return to England in 1242 again assisted his brother in a war against France, but was soon after deprived of his French domain Guienne. In 1256 he was chosen emperor of Germany by a faction while the opposing party declared Alfonso X. emperor. He was crowned king of the Romans in 1257, but was unable to obtain general recognition though he exercised all the rights of a sovereign. In 1264 he returned to England to assist his brother and was taken prisoner at the battle of Lewes, 13 May 1264. He returned to Germany in 1268, held a diet at Worms in 1269, after which he returned to England. He was one of the ablest and wealthiest princes of his day.

Consult: Lorenz, 'Deutsche im 13. und 14. Jahrhundert' (1863-7); Schirrmacher, 'Die letzten Hohenstauffen' (1871); Koch, 'Richard von Cornwall 1209-1257' (1888).

Richard Carvel, a historical novel by Winston Churchill, published in 1900. It is a story of the Revolutionary period and the hero, Richard Carvel, spends his early life in Maryland, where he is brought up by his grandfather, an ardent supporter of King George. The climax of the story is reached in a brilliant description of the victory of the Bon Homme Richard over the Serapis, in which battle Carvel is severely wounded.

Richard of Cirencester, sīs'ě-tēr, English chronicler of the 14th century. All that is known of his life is that he entered the Benedictine monastery of St. Peter's, Westminster, and was there in 1350; that in 1391 he obtained permission from his abbot to make a visit to Jerusalem; and that he died in his monastery in 1400 or 1401. He is the author of 'Speculum Historiale de Gestis Regum Angliæ,' a compilation from other chronicles, giving an account

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of the kings of England from 447 to 1066. His name is best known, however, in connection with a forgery of the 18th century. In 1747 Charles Bertram, an English teacher in Copenhagen, wrote to the well known English antiquary, Stukeley, that a friend of his had a manuscript work on Roman Britain, by a monk named Richard of Westminster, and a transcript of the MS. was subsequently forwarded, with a few lines in facsimile. The author was soon identified with Richard of Cirencester, who henceforth passed for the writer of a valuable Latin treatise, 'De Situ Britanniae.' The work was published in Copenhagen in 1757 and passed as authentic until B. B. Woodward, librarian of Windsor Castle, exposed the forgery in 1866.

Richard Roe. See DOE, JOHN.

Richards, rich'ardz, Charles Brinckerhoff, American engineer: b. Brooklyn, N. Y., 23 Dec. 1833. He was educated privately, and for many years was superintendent of the Colt's Arms Company at Hartford. He occupied a similar post with the Southwark Foundry and Machine Company at Philadelphia in 1880-4, was consulting engineer for numerous public buildings and since 1884 has filled the chair of mechanical engineering at Yale. He invented in 1861 the indicator for steam-engines, which bears his name; was one of the United States expert commissioners at the Paris Exposition in 1889, and prepared a large share of their official report; and is a member of various American and European scientific societies. He was editor of engineering and technical terms in Webster's 'International Dictionary.'

Richards, Ellen Henrietta Swallow, American chemist and educator: b. Dunstable, Mass., 3 Dec. 1842. She was graduated from Vassar in 1870, from the Massachusetts Institute of Technology in 1873, and in 1875 was married to Robert Hallowell Richards. She has been an instructor at the Massachusetts Institute of Technology since 1876, is chemist of the Manufacturers' Mutual Fire Insurance Company, and is also a specialist in water analysis. She has published 'Chemistry of Cooking and Cleaning' (1882); 'The Cost of Living' (1899); 'Air, Water, and Food' (1900); etc.

Richards, Henry Brinley, Welsh pianist and composer: b. Carmarthen, Wales, 13 Nov. 1819; d. London 1 May 1885. He was educated at the Royal Academy in London, gained a high position as a pianist and became a director and professor at the Academy. He made a specialty of Welsh music on which he frequently lectured, and won popularity by his compositions which include pianoforte pieces, part songs, songs, orchestral pieces, etc. His works include: 'Overture in F minor, for Orchestra' (1840); 'The Harp of Wales' (1863); 'God Bless the Prince of Wales' (1863); 'Let the Hills Resound' (1873); etc.

Richards, Laura Elizabeth Howe, American writer of juvenile fiction: b. Boston 1850. She is a daughter of Mrs. Julia Ward Howe (q.v.), and was married in 1871 to Henry Richards of Gardiner, Maine, where she has since resided. Among her numerous popular works are: 'The Joyous Story of Toto' (1885); 'Queen Hildegard' (1889); 'Captain January' (1890); 'Three Margarets' (1897); 'The Green Satin Gown' (1903).

Richards, Thomas Addison, author and artist: b. London 3 Dec. 1820; d. Annapolis 29 June 1900. He came to the United States in 1831 and settled in Georgia. He studied art at the National Academy in New York and with Daniel Huntington, and at an early age began writing and illustrating for publication. He organized the Woman's School of Design at Cooper Union in 1859 and was its first director. In 1868 he became professor of art in the University of the City of New York and after 25 years' service was made professor emeritus. He was a constant exhibitor at the National Academy of Design, became an associate in 1848, an academician in 1851, and was member of the council and corresponding secretary 1852-92. In the early '50s he was a frequent contributor of pictures and text to 'Harper's Magazine,' describing in his articles scenes in the United States and the homes of American authors. His landscape paintings produced in many parts of the United States and Europe are illustrative rather than creative. He was the author and illustrator of 'The American Artist' (1848); 'Georgia Illustrated' (1851); 'Romance of American Landscape'; 'Summer Stories of the South'; 'Pictures and Painters.'

Richards, William Trost, American artist: b. Philadelphia, 14 Nov. 1833; d. Newport, R.I., 8 Nov. 1905. He first studied under Paul Weber and in 1855 went abroad for observation and study in Italy and Paris, establishing a studio in Philadelphia in 1856. In his landscapes he adopted the minute method of drawing characteristic of the English Pre-Raphaelites, though he resembled them in no other respect, his subjects being transcripts rather than composed pieces. His greatest success was in his marines where he carefully studied the motion of waves in storm and calm. He painted numerous subjects along the Atlantic coast, especially near Newport where he later lived. He exhibited at the Royal Academy, London, at the Paris Salon and the various American Expositions. He was a member of the National Academy of Design. A series of his water-color marines hangs in the Metropolitan Museum, New York.

Richardson, rich'ard-són, Abby Sage, American lecturer and author: b. Massachusetts 14 Oct. 1837; d. Rome, Italy, 5 Dec. 1900. She was married to Daniel MacFarland, and in 1866 made her début as an actress. In 1868 she was divorced from MacFarland and was engaged to marry Albert Deane Richardson (q.v.) when he was shot by her former husband in 1869. She was married to Richardson a few days before his death and then retired from the stage, afterward devoting herself to lecturing and writing. She made several adaptations of plays from the French and her last work was a dramatization of Weyman's 'Sophia.' Her works include: 'Stories from Old English Poetry' (1871); 'Old Love Letters' (1883); 'Abelard and Heloise' (1884); etc. In collaboration with Grace Furniss she adapted the plays: 'The Pride of Jennico' and 'The Colonial Girl.'

Richardson, Albert Deane, American journalist: b. Franklin, Mass., 6 Oct. 1833; d. New York 2 Dec. 1869. He was a war correspondent for the New York Tribune during the Civil War and while trying to run the batteries of

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Vicksburg in 1863 was taken prisoner and held for 18 months. He was shot by Daniel MacFarland 26 Nov. 1869 and died a few days later. His miscellaneous writings were published by his widow, Abby Sage Richardson (q.v.), with the title 'Garnered Sheaves' (1871), and his other works include: 'The Field, the Dungeon, and the Escape' (1865); 'Beyond the Mississippi' (1866); 'A Personal History of Ulysses S. Grant' (1868); etc.

Richardson, Sir Benjamin Ward, English physician: b. Somerby, Leicestershire, 31 Oct. 1828; d. London 21 Nov. 1896. He was educated at Anderson College, Glasgow, and St. Andrews University, and in 1855 removed to London and for three years was lecturer on medical jurisprudence at the School of Medicine, in Grosvenor Place, and until 1865 lecturer on physiology. Sanitary reform and methods of producing anæsthesia were the two fields in which he was especially interested. Of the 14 anæsthetics that he brought into use methylene bichloride is most widely known. He introduced the ether spray for local anæsthesia, and the lethal chamber for the humane extinction of the life of animals. He also discovered the properties of amyl nitrite and introduced a number of bromides and other substances into use by the medical profession. He was a strong advocate of total abstinence from the use of alcohol, on the ground that its power as a drug required the greatest caution in its use. Aside from his scientific writing he produced biographies, plays and poems. The "Asclepiad," a series of original researches in the science, art and literature of medicine, was written entirely by himself and appeared quarterly from 1884 to 1895. Besides works already mentioned he wrote 'Diseases of Modern Life' (1876); 'National Health' (1890); etc.

Richardson, Charles, English philologist: b. London 5 July 1775; d. Feltham, Middlesex, 6 Oct. 1865. He studied law, but early turned his attention to literary pursuits and afterward opened a school at Clapham. He was pensioned in 1852. His works include: 'Illustrations of English Philology' (1815); 'New Dictionary of the English Language' (1837); 'On the Study of Languages' (1854); etc.

Richardson, Charles Francis, American educator: b. Hallowell, Maine, 29 May 1851. He was graduated from Dartmouth in 1871, was editor of the New York 'Independent' in 1872-8, of the Philadelphia 'Sunday School Times' in 1878-80, and of 'Good Literature,' New York, in 1880-2. Since 1882 he has occupied the chair of English at Dartmouth. He has published: 'A Primer of American Literature' (1878); 'The Cross,' poems (1879); 'The Choice of Books' (1881); 'American Literature 1607-1885' (1886-8); 'The End of the Beginning' (1896); etc.

Richardson, Ernest Cushing, American librarian: b. Woburn, Mass., 9 Feb. 1860. He was graduated from Amherst in 1880 and from Hartford Theological Seminary. In 1883-90 he was professor and librarian at the latter institution and since 1890 has been librarian at Princeton. He was American editor of Berner's 'Jahresberichte d. Geschichtswissenschaft'; critical editor of 'Hieronymus w. Gennadius de Viris Illustribus' (1896); and wrote: 'Bio-

graphical Synopsis of the Ante-Nicene Fathers' (1887); 'Classifications, Theoretical and Practical' (1901).

Richardson, Henry Hobson, American architect: b. Parish of St. James, La., 29 Sept. 1838; d. Boston 27 April 1886. He was graduated at Harvard in 1859 and in the following year went to Paris and entered the Ecole des Beaux Arts. Throughout his student life in Paris he worked under the instruction of L. J. André, and when his private fortune was swept away by the Civil War he secured through André's friendship an appointment in a government office in Paris. In 1865 he returned to the United States and located his business in New York. His first commission, received in October 1866, was for building the Church of the Unity in Springfield, Mass. The design of this church is the only instance of his following Gothic models; and this, which may in general terms be typical of the English Rural Gothic, yet presents certain independent features that show the practical bent of his mind. Shortly afterward he built the Boston & Albany railroad office in the same city and Grace Church in West Medford. In October 1867 he formed a partnership with Charles Gambrell which lasted until October 1878. The works of this period, which include several of his more important ones, and especially Trinity Church in Boston, were projected under the firm name, though with few exceptions were the conceptions of Richardson. In 1870 the commission was received to build the Brattle Street Church in Boston and the design he produced, Romanesque in general character, may be regarded, however, as rather transitional to that style that he worked in so consistently in the latter part of his life, and which received its first confirmation in the North Church of Springfield, built by him in 1872. The Brattle Street Church, now known as the First Baptist Church, has a fine tower ornamented below the upper arcade by a bold sculptured frieze. The church itself is ineffective in respect to the relations of its general masses with this superb tower, and, its acoustic properties being imperfect, the work is judged a partial failure.

Trinity Church in Boston was begun in 1872 and finished in 1877. This church shows the perfection of his individual style evolved from his study of the Romanesque churches of southern France. It is cruciform in plan, but its distance from apse-wall to façade is only about 39 feet in excess of the distance between the two walls of the transepts. This innovation in church architecture has had a powerful effect upon subsequent designs. After Trinity he produced only two other, and these comparatively unimportant churches, though he entered the competition for the Cathedral Church at Albany. His subsequent work was in the designing of municipal or commercial structures, and of these the one by which he wished to be judged was the Allegheny County Buildings - Court-house and Jail, of Pittsburg, Pa. These structures, however, he did not live to see completed. Other buildings designed by him are Sever Hall, and the Law School of Harvard University; the City Hall at Albany; parts of the New York State Capitol at Albany, in which he was associated with Leopold Eidlitz and Fred-

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erick Law Olmsted, his individual work being the Senate chamber, the Governor's room, the Court of Appeals chamber and the Western staircase; the Chamber of Commerce at Cincinnati and the Field Building at Chicago. Other buildings such as stores, railway stations, public libraries and private dwellings were designed by him. Consult: Van Rensselaer, 'Henry Hobson Richardson, and His Works' (1888).

Richardson, Sir John, Scottish naturalist and Arctic explorer: b. Dumfries, Scotland, 5 Nov. 1787; d. Lancrigg, near Grasmere, Scotland, 5 June 1865. He was educated at the University of Edinburgh and in 1807 entered the navy as assistant surgeon. In 1819 he was appointed surgeon and naturalist to Sir John Franklin's expedition to Hudson Bay and the Coppermine River. He was appointed surgeon of the Royal Marines at Chatham in 1824, but accompanied Franklin on his second Arctic expedition in 1825, resuming his duties at Chatham in 1827. He was knighted in 1846 and in 1848 set out with Rae in search of Franklin. The search was fruitless so far as finding trace of Franklin, but Richardson gained valuable information concerning the physical conditions of North America. In 1855 he resigned his position as surgeon to the Hasler Hospital at Gosport, which he had held since 1838. He was author of the articles 'Ichthyology' and 'Franklin' for the *Encyclopædia Britannica*; Vols. I. and III. of 'Fauna Boreali-Americana'; and also published: 'A Voyage Through Rupert's Land and the Arctic Sea' (1851); 'The Polar Region' (1861); etc.

Richardson, Leander, American journalist: b. Cincinnati 28 Feb. 1856. He has been engaged on various leading newspapers, was editor of the 'Dramatic News' in 1891-6, on the editorial staff of the *New York Morning Telegraph* 1896-1900, and is now (1906) editor of the 'New York Inquirer.' He has adapted several plays and operettas from the French and has written: 'The Dark City'; 'As Ye Sow'; the plays: 'The Millionaire'; 'Under City Lamps'; etc.

Richardson, Rufus Byam, American archæologist: b. Westford, Mass., 18 April 1845. He was graduated from Yale in 1869, studied divinity at Yale 1869-72, and at Berlin 1872-74. He was professor of Greek at the University of Indiana 1880-2, and at Dartmouth 1882-93, and since the year last named has been director of the American School of Classical Studies at Athens, Greece. He has edited *Æschines' 'Oration Against Ctesiphon'* (1889); and contributed frequently to the *American Journal of Archæology* (1892-1902). He wrote 'Vacation Days in Greece' (1903).

Richardson, Samuel, English novelist: b. Derbyshire, 1689; d. Parson's Green, near London, 4 July 1761. Up to the age of 50 the life of Richardson was not only uneventful, but undistinguished. The son of a joiner of the better class, who had moved from London owing to circumstances vaguely connected with Monmouth's rebellion, there is no clear evidence that he ever had more than what he calls "common school learning." His father's means did not permit him to take orders, but as a

concession to an early taste for reading, he was, when the family returned to the metropolis, apprenticed to John Wilde, an Aldersgate street printer. Here he exhibited the usual traits of the exemplary apprentice; proceeded, in due course, compositor, corrector, overseer, and master; and, as in duty bound, eventually married his employer's daughter. From Fleet street, where he first began business, he moved to Salisbury Court (now square); set up newspapers and books; worked on the publications of the Society for the Encouragement of Learning; and advanced generally in an industrious career. His first wife dying in 1731, he married again, his second wife being the sister of James Leake, a Bath bookseller. Children were borne to him by both his wives; but he was well past middle life before he had acquired any literary reputation, although he had long been known to his friends as what Goldsmith calls "a dab at an index," a clever compiler of opportune prefaces and "honest dedications," and, above all, a copious and indefatigable letter-writer.

This, from his childhood, had been his hobby. As a boy he was the chartered secretary of all the love-sick girls in the neighborhood; as a printer's apprentice he had corresponded voluminously with a gentleman who was a "master of the epistolary style;" and it is characteristic of the qualities he afterward developed as a novelist, that his communications were always of the moral or improving order. Out of these things arose his first literary effort. Two bookseller friends, Rivington and Osborn, suggested to him the preparation of a model letter-writer. Richardson at once went farther by proposing that the letters should teach those concerned to think as well as write. Such was the origin of the little-known volume of 'Familiar Letters' issued in January, 1741. Before it was finished, one of the model epistles, coupled with the recollection of something he had heard some 20 years before, led him to the composition of a story, also in letters, dealing with the triumphs of chastity in humble life. The idea rapidly grew into the famous 'Pamela; or, Virtue Rewarded' (1740), which not only obtained an immediate and unexampled success, but, by superadding to the patient realism of Defoe a power of minute mental analysis which Defoe did not possess, set a new fashion in fiction. It is this latter quality, together with the transfer of the fable from the impossible land of heroic romance to the very probable region of ordinary life, which gives the Salisbury Court printer his claim to have invented the novel of sentimental analysis as opposed to the novel of manners. Despite the moral professions of 'Pamela' many of its scenes are needlessly indelicate; and the final union of the heroine to the man who has repeatedly attempted her ruin is unpleasant,—to say nothing of the fact that there is a sordid air of calculation about the virtue she so vigilantly preserves. But dealing, as the story did, with real people in a real way, in what was, moreover, a dead season of letters, the book's success is not surprising. Fine ladies raved about it in public places. Clergymen praised it from the pulpit. Pope, sincerely or insincerely, declared it "would do more good than many vol-

umes of sermons," and the voices of the continuer and parodist were speedily heard in the land.

Of the inevitable sequel, 'Pamela's Conduct in High Life,' by John Kelly of the 'Universal Spectator,' nothing need be said, save that it forced Richardson upon a continuation of his own, now deservedly neglected. But among the numerous publications prompted by 'Pamela's' more assailable side, two in particular require to be mentioned. One was 'An Apology for the Life of Mrs. Shamela Andrews,' a clever but very gross attack upon the inner morality of the heroine. Richardson himself attributed this to Fielding, as did other of his contemporaries; but Fielding is never known to have acknowledged it. Ten months later Fielding issued 'Joseph Andrews,' which at all events set out with the open intention of burlesquing Richardson, although its writer promptly abandoned this inadequate motive with the development of more important characters than Pamela Booby, a name which, both in 'Shamela' and 'Joseph Andrews,' is cruelly filled in from Richardson's hero, "Mr. B." Either of these performances was sufficient to be a thorn in the side of 'Pamela's' sensitive author. But probably the worst thorn of all was the success of Fielding's 'Tom Jones,' which appeared not long after Richardson's next novel of 'Clarissa.'

'Clarissa; or the History of a Young Lady,' usually misnamed 'Clarissa Harlowe,' was published in 1747-8, in seven volumes and three instalments. The story, which deals with the "Distresses that may attend the Misconduct both of Parents and Children in Relation to Marriage," is an intensely tragic one. The heroine, a very pure and beautiful woman, is deliberately hunted down by a relentless seducer, whose eventual death at the hand of her guardian only faintly satisfies poetical justice. But in this book Richardson rises to the height of his powers. Encumbered by a story to be told in letters, and trammelled with his own prolixity, he nevertheless contrives to hold his readers fascinated, not only with the fortunes of his heroine, but with the individuality of her despicable but dazzling pursuer, who is drawn with surpassing dexterity. The intermittent mode of publication added flame to the public interest in the issue; and the writer was bombarded with appeals for a "happy ending." As to this, he showed more artistic fortitude than might have been expected. Imperfect as his education had been, he had learned from the 'Spectator' that to "make virtue and innocence happy and successful" was to defeat one of the great ends of tragedy, "the raising of commiseration and terror in the minds of the audience." So Clarissa Harlowe dies elaborately of a broken heart; and her history remains a masterpiece.

By this time Richardson was nearing 60, and might reasonably have held his hand. But the welcome accorded to Fielding's 'Tom Jones,' coupled with the importunities of his coterie of lady friends, soon engaged him in a third effort, the object of which was to delineate a model good man and fine gentleman combined. This was the 'History of Sir Charles Grandison' (1753-4), a book which

still has its admirers, though it does not by any means attain the tragic level of 'Clarissa.' That the hero of such a work should be something of a prig is inevitable; but he has many estimable qualities which are not ridiculous; and he is surrounded by a bevy of female worshippers who are drawn with unquestionable skill. Neither Clementina nor Harriet Byron could have been conceived by an inferior artist. It is easy to make fun of the little printer's superexcellent central figure; but there must, in spite of his long-windedness, have been something in the personage who could attract the admiration of both Ruskin and the Master of Balliol.

Beyond a very popular paper in Johnson's 'Rambler,' Richardson wrote nothing more of importance. He continued to prosper in his business, made money, became Master of the Stationers' Company, and eventually Law Printer to the King. He was a nervous, inoffensive, sensitive valetudinarian, delighting in the stimulus of feminine adulation rather than in the robust criticism of his own sex. His style is hopelessly pedestrian and diffuse; but it has an extraordinary cumulative power which attracts, and by degrees detains, the persevering reader. His faculty of minute imagination is wonderful; and he gradually acquired an extraordinary insight into the workings of the female heart. The English fiction which followed developed itself on somewhat different lines; but it is impossible to deny to him the credit of inaugurating the novel of sentimental analysis, which for a time became the fashion, even more in France and Germany than in England.

Bibliography.—Richardson's life has been written by Mrs. A. L. Barbauld, 'Memoir' prefixed to 'Correspondence' (6 vols., 1804); by Miss C. L. Thomson (1900), and by Austin Dobson, 'English Men of Letters' (1902). Consult also Scott's 'Lives of the Novelists' (1825); Mrs. Oliphant, 'Blackwood's Magazine' (March, 1869); H. D. Traill, 'Contemporary Review' (October, 1883), and Texte's 'Jean Jacques Rousseau' etc. (1895). There are editions of his novels by Rev. E. Mangin (1811); Sir Leslie Stephen (1883); Mrs. McKenna (1901), and Prof. W. L. Phelps of Yale. There are several portraits of Richardson by the painter Joseph Highmore.

AUSTIN DOBSON,

Author of 'Life of Richardson,' etc.

Richelieu, Armand Jean du Plessis, ărmăn zhôn dă plēs-sê rêsh-lê-e, Eng. rêsh'loo, **Cardinal**. Duc de, French prelate and statesman: b. Paris, according to Jal, who cites a register of baptism, 9, not as usually stated, 5 Sept. 1585; d. Paris 4 Dec. 1642. He was originally destined for the profession of arms but his brother, Alphonse, having resigned the bishopric of Luçon, this was bestowed on him by Henry IV. (1606). He obtained from the pope a dispensation allowing him to accept the office though under age, and on 16 April 1607 was consecrated by the Cardinal de Givry in presence of the pope himself (Paul V.). For several years he devoted himself to the duties of his see, reforming abuses, and laboring for the conversion of Protestants. But his ambition always made him turn his eyes toward the court, and having come to Paris in 1614 as deputy of

the clergy of Poitou to the States-General he managed to insinuate himself into the favor of the queen-mother, who obtained for him the post of grand-almoner, and in 1616 that of secretary of state for war and foreign affairs. On the disgrace of the queen-mother (1617) Richelieu fell with her, and was banished first to Blois and then to Avignon. In 1620 he managed to effect a reconciliation between Mary of Medici and her son Louis XIII. On 5 Sept. 1622 he obtained through her influence the cardinal's hat, and on 19 April 1624 was admitted into the council of state. No sooner was Richelieu secure in his high post than he began systematically to extend the power of the crown by crushing the Huguenots and overthrowing the privileges of the great vassals, and to increase the influence of the French monarchy by undermining that of the Hapsburgs, both beyond the Pyrenees and in Germany. Louis XIII., sensible of the energy of his minister, favored his plans, though he always showed a dislike for the man, whom he would gladly have destroyed had he been able to govern without him. The Huguenots had for a long time resisted the royal power; and bloody insurrections, in several preceding reigns, had arisen from their struggles in their attempts to gain political and religious power. The wisdom and mildness of Henry IV. had, indeed, assuaged the excitement of the contending parties, but his reign was too short to extinguish the fires. Richelieu resolved to crush the weaker by the aid of the stronger party, and thus to deprive those who should be disposed to resist his schemes of their main prop. The rallying-point of the Huguenots was Rochelle; and Richelieu neglected no means to make himself master of that city. In the celebrated siege of Rochelle he commanded the army in person.

Rochelle, supported by England, from which it continually received supplies, held out for a long time against all the efforts of the cardinal; and the hope of reducing it was already nearly abandoned, when Richelieu, by the erection of an immense mole, cut off the communication by sea, and finally compelled it to surrender by famine (1628). It would be a mistake to see in this war that Richelieu waged against the Huguenots an example of religious intolerance, for although this would have been quite in keeping with the spirit of his time, Richelieu was, with respect to this matter, in advance of his age. He destroyed the political consequence of the Huguenots as a separate body within the state, but by the Peace of Alais or Edict of Grace, which concluded the war (June 1629), he left them liberty of worship and equality of civil rights, and throughout his ministry employed them, with other citizens, in the army, the magistracy, and offices connected with the revenue. During the continuance of this war Richelieu had taken various steps in pursuance of the other main end of his internal policy, the overthrow of the power of the great nobles. In 1626 he ordered the demolition of all those feudal fortresses which could not be used for the defense of the frontiers, and which were a perpetual menace to the crown. The next step was the removal from court of the queen-mother who had become hostile, and endeavored to obtain Richelieu's downfall.

Saint Simon represented to the king the services of Richelieu and the impossibility of dispensing with his aid. Louis, therefore, ordered him to Versailles, and assigned him apartments in the palace directly below his own. This day (10 Nov. 1630), on which the hopes of the queen and of the cardinal's enemies were disappointed, was called the "Day of the Dupes" ("la Journée des Dupes"). The queen-mother was banished to Compiègne, her friends removed from place, and some of them thrown into the Bastille. This step, and the almost total annihilation of the privileges of the parliaments and the clergy, excited all classes against the despotic administration of the cardinal, and the discontent broke out in numerous risings and conspiracies, which, however, were not only suppressed by the prudence and vigor of his measures, but also contributed to the furtherance of his plans, and gradually rendered the royal power entirely absolute. In 1632 the royal arms, directed by Richelieu (in the previous year raised to the rank of duke), suppressed the rising in favor of the Duke of Orleans, the king's brother, to which the Duke of Montmorency had been induced to lend his support. Even those whom the king privately favored were obliged to yield to the all-powerful minister, and paid with their lives for their rashness in venturing to oppose him, as in the instance of Cinq-Mars, who in 1642, had entered into a conspiracy against him, which the king was, not without reason, believed to have favored. While the minister was thus extending the power of the crown at home he did not neglect the aggrandizement of the monarchy abroad. The Thirty Years' war gave him an opportunity of effecting this object. The same man who pursued, with the greatest severity, the Protestants in France, employed all the arts of negotiation, and even force of arms, to protect the same sect in Germany, for the purpose of humbling the house of Austria. In the early stages of the war he subsidized Count Mansfeld. Subsequently Gustavus Adolphus, king of Sweden, the great bulwark of religious liberty in Germany, received aid of every kind from Richelieu as long as he was not in danger of becoming formidable to France; but when the brilliant victories of Gustavus gave the cardinal reason to consider his power as more dangerous than that of Austria he abandoned that prince in the midst of his successes. The war which he undertook against Spain, and which continued till 1659, put France in possession of Catalonia and Roussillon, and the separation of Portugal from Spain was effected by his assistance (1640).

Richelieu must be allowed to have deserved the character of a great statesman; he cannot be denied the glory of having raised the power of the sovereign in France to its highest pitch; but he was proud, arrogant, and vindictive. He was a patron of letters and art, and founder of the French Academy and the Jardin des Plantes. Louis XIII. died a few months after him; but in the long reign of Louis XIV. the effects of Richelieu's policy were yet visible. Richelieu was the putative author of 'Mémoires' relating to the years 1632-5; 'Maximes d'Etat ou Testament Politique du Cardinal de Richelieu'; and 'Journal du Cardinal de Richelieu.' Of these the first two are doubtful, and the last almost

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certainly spurious. Consult: Hanotaux, 'Histoire du Cardinal de Richelieu' (1893-6); D'Avenel, 'Richelieu et la Monarchie Absolue' (1884-90); Lodge, 'Richelieu' (1896); Zeller, 'Louis XIII., Marie de' Médicis, Richelieu Ministre' (1899). See also FRANCE, *History*.

Richelieu, Chamblay, shān-blā, or **Sorel**, sō-rèl', a river in Canada, in the Province of Quebec; the outlet of Lake Champlain, and a tributary of the Saint Lawrence River. It is 80 miles long, from one to two miles wide in some places and from 1,000 to 1,200 feet in other parts. It is navigable its whole length, except a short distance where rapids are an obstruction. A canal has been built around the rapids. In the valley of this river, Chamblay Valley, were made some of the first settlements in Canada. The river was of importance in the discovery and settlement periods in America, as it was part of the great waterway into the interior; and for over two centuries, beginning with Champlain's Iroquois campaign in 1609, it was the scene of many battles.

Richepin, Jean, zhōn rēsh-pān, French poet and dramatist: b. Médéah, Algeria, 4 Feb. 1849. He began the study of medicine with his father, a physician, but gave it up and entered the Ecole Normale in the Department of Literature. After 1870 he engaged in journalism, editing 'L'Est,' and contributing to 'Mot d'Ordre,' the 'Corsaire' and 'Vérité,' in which latter he published 'Les Etapes d'un Refractaire.' Shortly afterward he published 'Chanson des Gueux,' for which he was fined and obliged to spend a month in prison, during which time he wrote 'Morts bizarres.' Works of this character have placed him among the most advanced of the naturalistic school; the boldness of his expression and the license of his subject have brought to him both applause and condemnation. In reply to criticism he admitted in 1881, in defense of his works, that his coarseness was perhaps unnecessary and repugnant, but not immoral. His works include verses under titles such as 'Caresses' (1877); 'Blasphèmes' (1884); 'La Mer' (1886); 'Mes Paradis' (1894); of romances 'Madame Andre' (1874); 'Sophie Monnier' (1884); 'Césarine' (1888); 'Braves Gens' (1888), besides many others; and of dramas 'Nana Sahib' (1882); 'Monsieur Scapin' (1886); 'Le Flibustier' (1888); 'Par le Glaive' (1892); 'Vers la Joie' (1894); 'Chemineau' (1897). He published also a work entitled 'Théâtre Chimérique' (1896) in 27 acts in prose and verse.

Richfield, rīch'fēld, Utah, county-seat of Sevier County; on Rio Grande Western railroad; 135 miles south of Salt Lake City. It was incorporated in 1878. It is the centre of an agricultural and stock-raising region. The public school system includes a high school founded in 1896; there is also an association library. Pop. (1910) 2,128.

Richfield Springs, N. Y., village in Otsego County; on the Delaware, Lackawanna & Western railroad; about one mile from Schuylers Lake, 25 miles south by east of Utica, and 13 miles north by west of Cooperstown. It is in a productive agricultural region; but the village is a well-known health resort on account of

its large number of mineral springs. It is also a famous summer resort. Nearby are many places of attraction, as Otsego Lake and vicinity. There are many beautiful drives and excellent roads to all the villages and towns in the vicinity. It has several small manufacturing establishments which more than supply local needs. The place was settled about the middle of the 18th century, but a permanent settlement was not made until after the Revolution. It was one of the favorite localities of the Indian tribes of eastern New York. Pop. (1890) 1,623; (1900) 1,537; (1910) 1,503.

Richford, rīch'fōrd, Vt., village in Franklin County; on the Missisquoi River, and on the Central Vermont and Canadian Pacific R.R.'s; 45 miles northeast of Burlington. It was first settled in 1795 and incorporated as a village in 1878. The village is built on both sides of the river which affords good water power; the lumber interests exceed all others in importance, and there are several lumber, saw, and planing mills. It is also in a maple sugar and agricultural region, and has a good trade, being a port of entry from Canada. It contains a high school, founded in 1892. Pop. (1890) 1,162; (1900) 1,513; (1910) 2,907.

Richibucto, rīsh-ē-būk'tō, formerly **Liverpool**, Canada, the capital of Kent County, New Brunswick, at the mouth of Richibucto River, 46 miles northeast of Saint John. It is a port of entry and the eastern terminus of a branch line connecting with the Intercolonial Railway at Kent Junction. The river is navigable for 15 miles, and there is a considerable export trade in lumber and fish. Shipbuilding is carried on.

Richland (rīch'land) **Center**, Wis., city, county-seat of Richland County; on Pine River and on the Chicago, Milwaukee & St. Paul railroad; 55 miles north-northwest of Madison. It was settled in 1849 and was made the county-seat in 1852. It is the centre of an agricultural, stock-raising, and dairying region, and has a large export trade in flour, cheese, etc. The river furnishes water power for manufacturing; and the city contains flour and saw mills, a tannery, and brick kiln. There is a public high school. Pop. (1910) 2,392.

Richman, rīch'man, **Irving Berdine**, American lawyer and diplomat: b. Muscatine, Iowa, 27 Oct. 1857. He was graduated from the State University of Iowa in 1883 and admitted to the bar in 1885. He was elected to the lower house of the State legislature in 1889 and 1891, and was United States consul-general in Switzerland, with residence at Saint Gall, 1893-8. He has published: 'John Brown Among the Quakers and Other Sketches' (1894); 'Appenzell: Pure Democracy and Pastoral Life in Inner Rhoden' (1895); 'Rhode Island: its Making and Meaning,' a historical work of much importance (1902).

Richmond, rīch'mōnd, **Countess of**. See BEAUFORT, MARGARET.

Richmond, Dean, American capitalist: b. Barnard, Vt., 31 March 1804; d. New York 27 Aug. 1866. He engaged successfully in the refining and selling of salt at 15, was a director in a Syracuse bank before he was of age and afterward engaged as a shipping and produce

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merchant at Buffalo. He was a leader in the movement which consolidated seven separate corporations into the New York Central Railroad Company in 1853, was its vice-president in 1853-64 and president in 1864-6. He was a recognized political leader but declined public office.

Richmond, Legh, English clergyman: b. Liverpool 29 Jan. 1772; d. Turvey, Bedfordshire, 8 May 1827. He was graduated from Cambridge in 1794, took orders in the Church of England in 1797, and in 1798 became curate of Brading in the Isle of Wight. In 1805 he was appointed chaplain in the Lock Hospital, London, and later in the same year became rector at Turvey, where he remained until his death. He was well known as a leader in the evangelical party, and wrote several tracts which were widely circulated, among them: 'The Dairyman's Daughter,' of which more than 4,000,000 copies in 19 different languages were circulated; 'The Negro Servant,' etc. He also published: 'The Fathers of the English Church, or a Selection from the Writings of the Reformers and Early Protestant Divines of the Church of England' (8 vols., 1807-11). Consult: 'Life,' by Grimshawe (1826, edited by Bedell 1846).

Richmond, Sir William Blake, English painter: b. London 29 Nov. 1843. He studied in the schools of the Royal Academy, where he received two silver medals in 1857 and had his portrait of his two brothers hung at the exhibition in 1861. He has traveled extensively in Italy, Greece, and Egypt studying the remains of ancient art, whence he has derived many subjects for his work. From 1878 to 1883 he was Stude professor at Oxford. His works include 'The Procession of Bacchus' (1865-8); 'The Life of Women' (1870), a series of frescoes for J. S. Hodgson of Haslemere; 'Electra at the Tomb of Agamemnon' (1877); 'Behold the Bridegroom Cometh' (1881); 'Release of Prometheus' (1882); 'Audience at Athens during the Representation of Agamemnon' (1885), now in the Birmingham Gallery. He has painted portraits of Darwin, Gladstone, Browning, William Morris, Holman Hunt, and Lord Lyttelton. Most notable of his works are the interior decorations and the glass mosaics of St. Paul's Cathedral. This work was executed by a staff trained under his personal supervision. He is an earnest advocate of the development of mosaic work in England, believing that this art should be applied only in the country and under the conditions of light in which the finished product is to remain. In 1895 he became a Royal Academician, and has been professor of painting at the Royal Academy. Consult his article on Mosaics in Vol. XXXI. of the New Volumes of the 'Encyclopædia Britannica.'

Richmond, Australia, a city of Victoria, suburban to Melbourne (q.v.). Pop. 38,000.

Richmond, Canada, the capital of Wolfe and Richmond counties, Quebec, 76 miles east of Montreal, on the Saint Francis River, an affluent of the Saint Lawrence. Its chief institution is Saint Francis College, affiliated to McGill University. The town has railway works, machine shops, and other industrial establishments.

Richmond, England, an ancient town in the county and 42 miles northwest of York (North Riding), on the left bank of the Swale. In and around the town are numerous interesting remains of antiquity, the most remarkable of which is the castle, comprising an area of nearly six acres, and one of the most majestic ruins in England; its great tower, about 100 feet high, is a fine and very perfect specimen of the Norman keep.

Richmond, Ind., city, county-seat of Wayne County; on the Whitewater River, and on the Pittsburg, C. & St. L., the Grand Rapids & I. R.R.'s; 68 miles east of Indianapolis and 70 miles northwest of Cincinnati. The Richmond Interurban and the Dayton & Western traction lines connect the city with all nearby places. Richmond was settled and platted in 1816 by Friends from North Carolina. It was incorporated in 1834 and chartered as a city in 1840. The city has about 300 manufacturing establishments, employing about 3,500 persons. The chief manufactures are threshers, drills, plows, engines, boilers, carriages, milling machinery, clothing, flour, and dairy products. It is the commercial and industrial centre of a large portion of the county. It has a number of fine public buildings, chief of which are the churches and schools. There are 26 churches, 10 public school buildings, two Roman Catholic parish schools, and one Lutheran parish school. Other educational institutions are Earlham College (Friends), Saint Mary's Academy (R. C.), one business college, and the Morrison-Reeves Free Public Library. The Eastern Indiana Insane Hospital, a State institution, is located here; also other charitable institutions. The three National banks have a combined capital of \$350,000; the annual amount of business is \$2,400,000. The government is vested in a mayor and a council of 14 members elected biennially by the people. The metropolitan police board is appointed by the governor. Pop. (1910) 22,324.

B. F. WISSLER,
Editor 'Sun-Telegram.'

Richmond, Ky., city, county-seat of Madison County; on the Louisville & N. and the Louisville & A. R.R.'s; about 25 miles south-southeast of Lexington and 135 miles east-southeast of Louisville. It is in an agricultural region; in the vicinity is found an excellent building stone. The chief manufactures are tobacco and dairy products, and the trade is chiefly in farm and tobacco products, cattle, and horses. Its educational institutions are Madison Institute, under the auspices of the Church of the Disciples, Walter's Collegiate Institute, a Presbyterian institution, and public elementary schools. One of the most desperate battles of the Civil War was fought at Richmond. The Confederate forces under E. Kirby Smith defeated a much larger Federal force under Manson and Nelson. Pop. (1890) 5,073; (1900) 4,658; (1910) 5,340.

Richmond (Ky.), **Battle of**, the most decisive Confederate victory of the Civil War. On 14 Aug. 1862 Gen. E. Kirby Smith left Knoxville, Tenn., to unite with Gen. Bragg in northern Kentucky. He passed through Big Creek Gap of the Cumberland Mountains and, leaving Gen. Stevenson's division to observe

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1. Washington Monument, near State Capitol.
2. Capitol Square, showing the new City Hall Building.

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the Union forces at Cumberland Gap, penetrated Kentucky with about 6,000 men. Preceded by Col. J. S. Scott's cavalry force of 900 men, he moved in the direction of Frankfort, threatening both Louisville and Cincinnati. Gen. Lew Wallace, with a regiment, hastened from Louisville to Lexington, and there found other forces, over which he was placed in command; new regiments came from north of the Ohio; but as Wallace was about to move forward and oppose Smith he was superseded by Gen. Nelson, who had been ordered by Gen. Buell to take charge of affairs in Kentucky. Upon his arrival Nelson organized the troops at Lexington into a division of three brigades, under Gens. M. D. Manson, Charles Cruft, and J. S. Jackson; and hearing that the Confederates were approaching, he sent forward some Kentucky cavalry to oppose them. There were several sharp cavalry affairs, in which the Union cavalry showed such aggression that Kirby Smith determined to make an immediate attack upon the Union forces at Richmond, although his troops were jaded by long and laborious marches, and Gen. Heth's division of 4,000 men was still far to the rear. He had for the attack Cleburne's and Churchill's divisions of 6,000 men and Scott's cavalry brigade of about 850, and the advance was ordered for the morning of 30 August. Scott's cavalry encountered Manson's brigade about half a mile south of Rogersville, and Cleburne, coming up with two brigades, attacked Manson, who, reinforced by a regiment of Cruft's brigade and a battery, endeavored to turn Cleburne's right, but was repulsed. Meanwhile Churchill's division had come to Cleburne's support; a brigade flanked Manson's right and drove it back in disorder; and as the rout became general, another of Cruft's regiments came up, but was quickly repulsed with heavy loss. Another position was taken farther to the rear, where the troops were under partial cover, with artillery on the flanks. This the Confederates soon attacked; Churchill's division struck Cruft's brigade, which was on the right, and drove it back in disorder; and Cleburne advancing in front, Manson's entire line went back, the Confederates in close pursuit. Manson had but partially formed another line in front of Richmond, when Gen. Nelson came on the field and selected a new line near the town and cemetery; and the troops, barely 2,200 in number, had scarcely taken position when the Confederates were upon them in flank and front, fired about three volleys, and the Union troops gave way in utter rout. Early in the day Scott's cavalry had gained the road in rear of Richmond, and the knowledge of the fact increased the demoralization. Nelson, wounded, narrowly escaped to Lexington and thence to Louisville. Manson was wounded and taken prisoner, with over 4,000 of his men, while nine guns, over 6,000 muskets, and the entire wagon-train were lost. The fragments of the army made their way to Louisville. The Union troops engaged numbered 6,500 raw men; the Confederates about 6,800 veteran troops. The Union loss was 206 killed, 844 wounded, and 4,303 captured or missing, an aggregate of 5,353. The Confederate loss was 78 killed, 372 wounded, and one missing, an aggregate of 461. Gen. Heth, with his division of 4,000 men, joined Smith after the battle, and marched to Lexington,

where he arrived 2 September, and the legislature, then in session at Frankfort, fled to Louisville. Heth marched northward to Cynthia, and to within a few miles of Covington, to threaten Cincinnati, which he found too well defended to attack, and being in turn threatened, he withdrew to join Smith, who waited at Lexington to join forces with Gen. Bragg, then operating against Gen. Buell. (See *PERRYVILLE, BATTLE OF*.) Consult: 'Official Records,' Vol. XVI.; Van Horne, 'History of the Army of the Cumberland,' Vol. I.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III. E. A. CARMAN.

Richmond, Maine, town in Sagadahoc County, on the Kennebec River and on the Maine Central railroad, 37 miles north-northeast of Portland. It was first settled in 1700; in 1719-20 a fort was erected here for the defense of the settlers against the Indians; this fort twice resisted attack, and was finally dismantled in 1754. The town was incorporated in 1823. The chief industries of the town include a cotton mill and shoe factory, ice cutting, and agriculture; there are also saw and planing mills and some trade in lumber. The town has a public high school, with which the Richmond Academy (incorporated 1861) was united, and also a public library. Pop. (1890) 1,394; (1900) 2,097; (1910) 1,858.

Richmond, Mo., city, county-seat of Ray County; on the Atchison, Topeka & Santa Fé railroad; 58 miles southeast of St. Joseph. The county-seat was removed to Richmond from Bluffton in 1827. It is the centre of a fertile agricultural and stock-raising region; and there are coal mines in the vicinity which yield excellent quality of bituminous coal. It also has wagon and plow factories, flour mills, and a foundry. It contains the county court-house, and has electric lights and modern waterworks. It is well provided with educational facilities, having two public high schools, of which one, the Lincoln high, is for colored pupils; and is also the seat of Woodson Institute, a coeducational secondary school under the auspices of the Methodist Episcopal Church, South. Pop. (1910) 3,664. 1

Richmond, Va., city, port of entry, capital of the State; county-seat of Henrico County; on the James River, the Richmond-Washington Line, the Atlantic Coast Line, the Chesapeake & Ohio, the Seaboard Air Line, and the Southern R.R.'s; about 115 miles almost due south of Washington, D. C., and 90 miles from the mouth of the river at Chesapeake Bay. Area 4.85 square miles, but including the suburbs, 16 square miles. The surface is hilly, rising from the river and the valley of Shockoe Creek in a series of hills, almost terrace-like in formation, until it reaches altitudes of from 170 to 250 feet above sea-level, at which altitudes there are plateaus constituting the principal residential sections. It was originally built on seven hills, and was often called the "Modern Rome." In 1842, when Charles Dickens visited the city, it had extended its limits to another hill, and he wrote of it as "delightfully situated on eight hills overhanging James River."

Regular lines of steamers, the Virginia Navigation Company and Old Dominion, connect

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the city with Atlantic and Chesapeake ports, and furnish a cheap outlet for shipping products to other parts of the United States and to foreign ports. James River (q.v.) furnishes water power which is used extensively for manufacturing and of the total horse-power 14,000 utilized, 10,000 horse-power being electrically developed, it propels the entire street car system and supplies the electric lights of the city. Several bridges (four railroad and two for vehicles, street cars and foot passengers) cross the river and connect the city with Manchester, and beyond its suburbs with Forest Hill Park, Bonair, Granite, Spring Hill, and other places. A seventh is being constructed especially for the street cars.

There are about 120 miles of streets, 40 miles of which are sewered, and about 30 paved. The streets are all fairly wide. Main, the chief thoroughfare, is a broad, well-built street; Broad is the widest street in the city; Grace and West Franklin, as well as some of the suburbs, are residential sections. The water supply, which when clear is most excellent for domestic and all other purposes, is obtained from the James River at two points above the city. The water is pumped into two reservoirs from which it is piped for distribution throughout the city, and an extensive settling basin and system for insuring its clarification at all times is being pushed to completion. The natural drainage makes the city healthful, and warm winters and temperate summers attract many home seekers who desire a mild climate.

Industries.—The chief industries of the city are connected with the preparation of tobacco for local use and for shipment to outside markets. The Federal census of 1900 gives 49 establishments for the manufacturing of tobacco; the amount of capital invested, \$3,054,450, and the value of the products for the year mentioned, \$10,537,803. There were 5,666 employees, to whom were paid \$1,506,090 wages for the same year. The establishments were 17 smoking and chewing tobacco factories, 22 cigarette and chee-root factories, and 10 stemmeries and packing houses. The foundries and machine shops number 18 establishments, with invested capital, \$5,164,103; and the annual value of products \$2,594,186. There were six establishments engaged in preparing fertilizers for market. The invested capital was \$2,163,731, and the value of the products, \$1,045,063. Other manufacturing establishments were wagon and carriage works, lumber mills, railroad car factory, confectionery factory, and baking powder works. In 1900 the city contained 763 manufacturing establishments which represented 100 different industries. The capital invested in manufacturing concerns was \$20,848,620; there were 17,885 persons employed, and the annual wages amounted to \$6,447,929. The amount paid for raw material the same year was \$13,161,697; and the total product for the year was valued at \$28,900,616.

Commerce.—The location and the facilities for transportation make Richmond the commercial centre of a large extent of southeastern Virginia, and an important point of distribution for the Carolinas and adjoining Southern States. For the year ending 30 June 1909, the custom house records showed the amount of imports as \$696,984; but these figures are entirely misleading as a measure of its foreign trade, as

its imports and exports are principally cleared through the custom-houses of New York and other northern ports. The amount of trade with the United States Atlantic coast cities and the cities and towns of the interior of the State is very large.

Banking and Finances.—The city has 32 banking institutions, including 5 national, 5 state banks, 6 savings banks, 3 trust companies, 13 private bankers and brokers, one loan and deposit company. The combined capital of the national and state institutions is \$3,771,062.50; the surplus, \$3,190,478.48; the deposits, \$21,491,616.34; loans and discounts, \$19,251,540.43; and total resources, \$31,491,616.34. The assessed valuations of the city in 1910 were, real, \$44,560,516; personal, \$37,063,705; total, \$137,564,468. The receipts for a single year a decade ago were something over \$1,875,000; and the expenditures a little less. The chief items of expense in the budget for 1904 are, to the sinking fund for interest and redemption, \$473,311.26; a special appropriation of \$20,000 for opening and widening streets and one of \$50,000 for a new gas holder in west end are also in this budget; for schools, \$179,743.74; police department, \$113,100; fire department, \$116,150; waterworks, \$78,385; gas works, \$191,500; streets, \$183,010. The net public debt was (1910) \$8,804,263. The municipal assets, including waterworks, gas plant, city-hall, parks, market-houses, school buildings, etc., were valued at \$8,000,000; and there was to the credit of the sinking fund in bonds and cash something over \$830,000.

Public Buildings, Parks, and Monuments.—Richmond is historic ground and her noted public buildings are valued more on account of their association than for the architectural merits which they possess. Capitol Square, on Shockoe Hill, has an area of 12 acres. It takes its name from the State Capitol which is on the square. The Capitol was built after a model procured by Thomas Jefferson when he was in France, and which was patterned after Maison Quarriés of Nismes, an ancient Roman temple, only changing the columns from the Corinthian to the Ionic. The corner-stone was laid in 1785, and on 19 Oct. 1789, the eighth anniversary of the surrender of Lord Cornwallis at Yorktown, the Virginia State Legislature convened in the new Capitol. The model for the Capitol sent from France by Jefferson is still in the building. In the rotunda is the most valuable piece of marble in America, Houdon's statue of Washington, modeled from life. The General Assembly of Virginia (1903-1904) appropriated \$250,000 for the purpose of adding wings to the east and west sides of this building, for steps to the imposing portico at the southern end, and for some interior improvements. These additions will be in harmony with the architectural style of the original building, will preserve its most characteristic features and furnish additional room, much needed by the General Assembly and the various State departments.

On the same square is the library building, which contains the parole signed by Lord Cornwallis at Yorktown, the original Virginia Bill of Rights, and the Virginia ordinance of secession. The executive mansion is on this square, on land which was once a part of Nathaniel Bacon's plantation. The old building known as the Bell House has many interesting associations.

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The old bell, purchased in 1790, was for years a "voice to the people."

Among the famous pieces of statuary on the grounds is the equestrian statue of Washington, by Thomas Crawford (q.v.). Of the statues at the base Crawford completed only Thomas Jefferson and Patrick Henry; the other pieces, George Mason, John Marshall, Thomas Nelson, and Andrew Lewis, were made by Randolph Rogers. Nearby stands a fine marble statue of Henry Clay, by Joel T. Hart; also several other marble statues and a bronze statue of "Stonewall" Jackson, by Foley. Three fountains add to the beauty of the square. The largest park of the city has an area of 300 acres. It has a lake, a fine boulevard, and the chief reservoir. Monroe Park has many fine trees and some good pieces of statuary. Libby Park is on Libby Hill. It is terraced from Main Street to the summit, and a monument in honor of the Confederate soldiers and sailors stands on the highest point. Chimborazo Hill Park has an area of 36 acres. A Government road leads from the park to the National Cemetery where are buried 6,547 Federal soldiers who fell in the attempts to capture the city during the Civil War. Jefferson Park is between Pleasant and Marshall streets; Gamble's Hill Park is on a relic of the James River and Kanawha Canal, still used as a race to a number of important water-power plants. It also overlooks the famous Tredegar works where cannon were made, and the no less famous Belle Isle, the site of the Old Dominion Iron and Nail Works, where a number of Federal prisoners were confined during the war between the States. Lee Circle, in the western part of the city, has a bronze equestrian statue of Robert E. Lee (q.v.), by Mercie, a French sculptor. It represents the General on "Traveller," his well-known war-horse. In Howitzer Park is a monument in memory of the Richmond Howitzer battalion. A favorite drive is the one to Hollywood, where sleep 12,000 Confederate soldiers. A monument of granite, pyramidal in form, 90 feet high and softened by a covering of Virginia creeper and ivy, has been erected to the memory of the Confederate dead soldiers. Many of Virginia's famous men are buried here. Tyler and Monroe, Presidents of the United States; John R. Thompson, the poet; Matthew F. Maury, "Pathfinder of the Seas"; John Randolph; Jefferson Davis, president of the Confederacy, and a number of Confederate Generals. The most noted parks and squares have a combined area of 358 acres; but the little squares and circles, not mentioned as noted, ornament the city, and give it an artistic air.

Other historic and prominent landmarks are the residence occupied by General Lee and his family, now the home of the Virginia Historical Society; the house occupied by Jefferson Davis while he was president of the Confederate States; and the famous Monumental Church on Broad Street, formerly called Academy Square. At one time a large wooden building, built for an Academy of Fine Arts, occupied the present site of the church. In 1788 the old building saw a brilliant gathering of "history makers," who met to discuss the document proposed as the Constitution of the United States of America. Madison, Mason, Marshall, Pendleton, Randolph, Lee, Wythe, and others were

there, and finally the Constitution as framed at Philadelphia was ratified by Virginia. Only 23 years afterward occurred in the same building at a theatre the terrible disaster which resulted in the death of 72 persons, among whom was the Governor of the State. The present church is their monument; the portico extends over their tombs and the charred remains. The house once the home of Chief Justice Marshall stands on the street named in his honor. Saint John's Episcopal Church, built in 1740, is in an excellent state of preservation and is still used for religious services. Richard Randolph, who superintended the building of the church, was a descendant of Pocahontas. In the quaint old churchyard surrounding it is the grave of George Wythe, one of the signers of the Declaration of Independence. In this church, on 20 March 1775, was held the famous Virginia Convention which met to hear a report of the first Continental Congress, and to discuss the political situation of the country. The convention feared to hold a session in Williamsburg, the capital, on account of the hostility of Lord Dunmore. The church was the only place in Richmond large enough to contain the convention. It was at this convention that Patrick Henry made his famous speech, ending with the words: "Is life so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take, but as for me, give me liberty or give me death." The place where the patriotic orator stood is pointed out to strangers. Another remarkable event occurred on 6 Jan. 1781, when Benedict Arnold, at the head of a British force of 900, entered the city, and a number of the soldiers were quartered in this old church. The oldest house in Richmond, a stone building on Main Street, was built in 1737 by Jacob Ege. It is now used as a historical museum. The Valentine Museum contains over 100,000 archaeological specimens, also many fine pictures and statues. This valuable museum was given to the city by Mann S. Valentine. His brother, Edward V. Valentine, the sculptor, has given to the museum several valuable pieces of statuary.

The most costly and the most ornate building in the city of Richmond is the City-Hall, completed about 10 years ago, at an outlay of over \$1,400,000. It is built of Richmond granite, dressed and quarry-faced, is completely fire-proof, commodious in all its appointments and should fully meet all of the requirements of the city for the next hundred years or more.

Education.—The city has an excellent school system; there are public and parish elementary schools for white and similar ones for colored pupils, a high school, normal school for whites and one for colored, Virginia Mechanics' Institute, which has evening classes, kindergartens, and a number of private schools. The secondary schools and colleges are the Richmond Female Institute (Baptist), founded in 1854; Richmond Female Seminary (P. E.); Hartshorn Memorial College for Colored Girls (Baptist), opened in 1883; Visitation Academy (R.C.), founded in 1860; Saint Peter's Academy (R. C.); Saint Joseph's Academy (R. C.); Saint Patrick's Academy (R. C.); Sacred Heart Academy (R. C.); Saint Mary's Benedictine Institute (R. C.); Training School for Kindergartners; Art School;

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of Art Club, and Saint Andrew's School, the Medical College of Virginia (1837); University College of Medicine (1893); Richmond Theological Seminary (Baptist), opened in 1867; Richmond College (Baptist), opened in 1832; and beyond the city limits, Hartshorn and two others. There are five public libraries with an aggregate of 60,000 volumes.

Churches.—The city has 130 religious organizations and 90 church edifices; 65 for white people and the others for colored. The different denominations rank according to church edifices and organizations as follows: Baptists, Protestant Episcopalians, Methodists, Presbyterians, Roman Catholics, Lutherans, Jews, Christians, Friends. The Roman Catholic Cathedral, being built with means supplied through the munificence of Mrs. Thomas F. Ryan of New York, will be the finest church edifice in the city.

Charitable Institutions.—There are here Saint Sophia's Home for the Aged; the Sheltering Arms; the Home for Incurables; Foundling Asylum; Retreat for the Sick; City Orphan Asylum; Lee Camp Soldiers' Home; and Saint Joseph's Orphan Asylum. There are a number of public and church aid societies and various charitable organizations.

Hospitals.—Saint Luke's Hospital is one of the best equipped institutions in the city.

History.—In May 1607, John Smith, Captain Newport, and others ascended the James River as far as the place where Richmond now stands. In September, 1609, Smith, who was the president at Jamestown, again ascended the river to find a better location for the colony than Jamestown. He purchased from the Indians some land near the present site of Richmond, and so pleased was he with the place that he called it "None Such."

"Forte Charles" was built below the falls, in 1645. In 1675 and in 1687 a further grant of 950 acres, which tracts included the land upon which Richmond now stands; but the city was not founded until some years later by his son, Colonel William Evelyn Byrd. This founder of Richmond seems to have been versed in methods of founding cities which are now called modern. He established two cities "on paper," one at Sohocco's, to be called Richmond, and at the "Point of Appamattuck River," to be called Petersburg. He engaged Major Mayo to lay out the squares, streets, etc. Then he proceeded to advertise his cities, inserting a notice in the Virginia 'Gazette,' April 1737, "that on the north side of James River, near the uppermost landing and a little below the falls, is lately built by Major Mayo a town called Richmond, with streets 60 feet wide, in a pleasant and healthy situation, and well supplied with springs of good water." Byrd was a learned man as well as a good advertiser. He brought to the New World a large and well selected library, a catalogue of which is in the Franklin Library in Philadelphia. He proceeded to build a mill, a warehouse, and such other buildings as were necessary. In its early days the place was called Byrd's Warehouse. In 1742 the Assembly of Virginia established the town, and the wide streets and squares were at last laid out. In 1779 the capital of the commonwealth was removed from Williamsburg to Richmond. Then the place was only a number of disconnected houses in small groups, with rough ground and

rocks intervening. Benedict Arnold entered the city in 1781 and burned a portion of it, as has been mentioned above.

In 1782 Richmond was incorporated as a city, and in 1785 the foundation of the Capitol was begun. This Capitol, from its opening in 1789 down to the present, has been the scene of many stirring historical events. In 1798-9 took place the famous debates which ended in the adoption of the resolutions, drafted by James Madison, regarding the interpretation of the Federal compact. What powerful conventions were held here when such men as Monroe, Madison, John Randolph, and Marshall were members. The convention of 1851 extended the privilege of suffrage, and here in 1861 the Act of Secession was adopted; and in June of the same year, Richmond was made the capital of the Confederate States. In July 1862, the Congress of the Confederacy convened here, and remained in session until April 1865. During the Civil War the city was the great objective point of the chief operations of the Union Army in the East. Again and again the Union forces marched to the battle cry "On to Richmond," and again and again were they repulsed. For three years, from May 1862 to April 1865, the city was almost in a state of siege; the records tell of 15 pitched battles and 25 skirmishes and sharp engagements which were fought in efforts to capture the city. When its defenders yielded, and left the city, they set fire to the arsenals and large tobacco warehouses, and burned the bridges directly after crossing them, which caused a most extensive conflagration in the principal business sections of the city. On 27 April 1870, at a contest over the mayoralty before the Supreme Court of Appeals, over 60 persons were killed by the giving away of the floor of the court room. A large number of people were in the building.

The suburbs of Richmond contribute to the charms of the city and to its history pages. The lines of earth work defenses and the marks of shot and shell are still visible. The broad, shady avenues of stately, beautiful trees lead out to battle grounds now covered with the houses and business establishments of busy, peaceful people.

Pop. (1890) 81,388; (1900) 85,050. But these figures to no extent marked the growth and prosperity of the city. With the exception of the annexation of Lee District, which was just beginning to be built up, the corporate limits had not been extended since 1867, and in many quarters the suburbs were quite quickly settled, and were undistinguishable from the adjacent districts of the city.

The rural free delivery of the Richmond post-office served a suburban population of from 25,000 to 30,000, most of which was added to the city population when the much needed expansion of the city limits went into effect. This placed it, where it legitimately belonged, in the ranks of cities beyond the 100,000 limit. Pop. (1910) 127,628.

Consult: Chesterman, 'Guide to Richmond'; Powell, 'Historic Towns of the Southern States'; Poindexter, 'Richmond'; Scott, 'Capitol of Virginia.'

WILLIAM G. STANARD,
Secretary of the Virginia Historical Society,
Richmond, Va.

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Richmond (Va.). Kilpatrick's Expedition to. In February 1864 a cavalry expedition organized to make a dash on Richmond, distribute President Lincoln's amnesty proclamation, and liberate the Union prisoners in the city and on Belle Isle. The expedition was put under command of Gen. Kilpatrick, who, with 4,000 men and a battery of artillery, marched from Stevensburg, crossed the Rapidan at Ely's Ford, early on the night of 28 February, and moved swiftly to Spottsylvania Court House. Here Col. Ulric Dahlgren, with 500 men, was detached from the column, on the morning of the 29th to cross James River and enter Richmond from the south. Kilpatrick continued his course to the Virginia Central Railroad at Beaver Dam Station, thence to Ground Squirrel Bridge over the South Anna, and to a point five miles from Richmond, which was reached on the morning of 1 March. Believing that his approach was unknown, and that a small force of infantry only occupied the intrenchments, he moved on the Brook road toward the interior line of defensive works, driving in a few pickets, and found infantry and artillery in the works—500 men and six guns. He opened with artillery, and was about to attack, when he thought he saw reinforcements of infantry filing into the Confederate works, and, feeling certain that Dahlgren had failed, and that his own attack would be a bloody failure, he withdrew to Atlee Station, north of the Chickahominy, and went into camp. Here he was attacked during the night by Wade Hampton's and Bradley T. Johnson's cavalry, the latter having followed him from Beaver Dam Station. The camp of one of his brigades was captured, and Kilpatrick, retreating, was followed down the Peninsula, being joined near Tunstall's Station next day by nearly 300 of Dahlgren's men. He reached Williamsburg on the night of the 2d.

Col. Dahlgren moved from Spottsylvania Court House across the Virginia Central Railroad, near Fredericksburg, to James River, near Goochland Court House, where he expected to cross the river, release the prisoners on Belle Isle, and enter Richmond from the south, to unite with Kilpatrick at 10 A.M. of 1 March. But he could find no ford, so marched by the north bank of the river, approaching Richmond late in the afternoon, and coming upon cavalry and infantry, with which he skirmished sharply until night. Hearing nothing from Kilpatrick, except his guns, heard early in the afternoon, and rightly believing that he had failed, Dahlgren withdrew, designating Capt. Mitchell, 2d New York Cavalry, to command the rear guard. In the darkness the column became broken, Dahlgren, with less than 100 men going in one direction, and Mitchell in another. Mitchell succeeded in joining Kilpatrick at Tunstall's with about 260 men. Dahlgren crossed the Pamunkey at Hanover Town, and the Mattaponi at Aylett's Ford, and about midnight 2 March fell into an ambushade and was killed. Others were killed and wounded, nearly all were captured. Capt. Mitchell reports that of the 500 men of Dahlgren's command 61 were killed and wounded, and 138 captured. The total loss of Kilpatrick's command, including Dahlgren's, was about 350. Consult: 'Official Records,' Vol. XXXIII.; Humphrey's 'From Gettysburg to the Rapidan'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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Richmond (Va.), Sheridan's Raid on the Communications with, a movement which included the battle of Yellow Tavern. At day-break 9 May 1864 Gen. Sheridan, with 10,000 cavalry and six batteries, started from near Todd's Tavern to cut the railroads entering Richmond from the north and northwest. He moved on the Telegraph road; Merritt's division crossed the North Anna at Anderson's Ford at dark and encamped; the rest of the column, harassed by a brigade of Stuart's cavalry, halted for the night on the north side of the river. The march was resumed early on the 10th, several miles of the Virginia Central Railroad destroyed, with rolling-stock and supplies, and at night Sheridan crossed the South Anna, halting at daylight of the 11th on the south bank. Early in the day Davies' brigade encountered Munford's cavalry at Ashland, on the Fredericksburg Railroad, drove it from the place, destroyed the depot and several miles of railroad, and joined Sheridan's main body at Allen's Station. Meanwhile Gen. Fitzhugh Lee's cavalry division had been rapidly marching by a circuitous route to interpose between Sheridan and Richmond, and had reached Yellow Tavern, on the Brook road, six miles from Richmond. Lee had barely 4,500 men. Sheridan's whole force advanced, Merritt's division leading, followed by Wilson's and Gregg's. Merritt attacked and gained the Brook road at Yellow Tavern, but Gen. Stuart, in command of the Confederates, seized a position on his flank and enfiladed his line with artillery. Then Custer's brigade, supported by Wilson's division, charged the flanking force, breaking it and capturing two guns. In this encounter Stuart was mortally wounded. Stuart's detached brigade, under Gen. James B. Gordon, fell upon Sheridan's rear, but Gregg drove it back toward Ashland. Fitzhugh Lee's division retreated toward Richmond. The losses on both sides were severe. Sheridan followed Lee's division and entered the most advanced line of works covering Richmond. Sheridan had intended to keep south of the Chickahominy and march by way of Fair Oaks, to make a demonstration on Richmond. Marching during the night, at daylight of the 12th he massed his force at Meadow Bridge, overlooking the line of the Virginia Central Railroad and the Mechanicsville pike. After demonstrating on the Confederate works, which were found too strong to be attacked, he determined to recross the Chickahominy at Meadow Bridge. The bridge, which had been partially destroyed, was held by some of Gordon's cavalry and a battery on the north side. Merritt's division crossed after a severe engagement, in which Gen. James B. Gordon, commanding the Confederate cavalry, was killed. Meanwhile, Wilson's division could not pass the second line of the Richmond defenses, on the Mechanicsville road, and was attacked by Barton's and Gracie's infantry brigades and some dismounted cavalry, who, advancing from the works, attacked both Wilson and Gregg, at first with success, driving Wilson in some disorder. After a severe contest the Confederates were driven back to their works, and between 3 and 4 P.M. Wilson and Gregg crossed the Chickahominy above Mechanicsville bridge, and Sheridan encamped his corps near Gaines' Mill. Next day he crossed to the south side of the Chickahominy by Bottom's bridge, marched through White Oak Swamp and, on the

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14th, encamped in the vicinity of Haxall's Landing, on James River. He made several demonstrations on the New Market road, in the direction of Richmond, and having drawn supplies from Gen. Butler's army, started on the 17th to rejoin the Army of the Potomac, marching by way of White House, on the Pamunkey. Detachments were sent to destroy the railroad bridges over the South Anna and to demonstrate on Richmond, and 24 May Sheridan rejoined Grant's army near Chesterfield bridge on the North Anna. The Union loss in the movement from 9 May was 64 killed, 337 wounded, and 224 missing. There are no reports of Confederate losses. Consult: 'Official Records,' Vol. XXXVI.; Humphreys, 'The Virginia Campaign of 1864-5'; Sheridan, 'Personal Memoirs,' Vol. II.; McClellan, 'Life and Campaigns of Gen. Stuart'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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Richmond (Va.), Union Campaigns Against. As the capital and political centre of the Southern Confederacy, defended by its best army, Richmond became and continued to be the objective point of the Union armies. The first campaign against it was that of Gen. McDowell, which ended in Union defeat at Bull Run, 21 July 1861. (See **BULL RUN, FIRST BATTLE OF.**) The next campaign had its base at Fort Monroe, from which, 4 April 1862, Gen. McClellan advanced with the Army of the Potomac up the York Peninsula. After the siege and capture of Yorktown and the battle of Williamsburg (q.v.), McClellan crossed the Chickahominy, and 30 May his outposts were within five miles of Richmond. Meanwhile, after the destruction, by her commander, of the Confederate ram Merrimac, Capt. John Rodgers, with three Union gunboats, ascended James River until he reached Fort Darling (q.v.), on Drewry's Bluff, eight miles below Richmond, where, 15 May, he was stopped by the fire of heavy guns. Com. Goldsborough, commanding the navy in those waters, now proposed to McClellan to co-operate with him in a joint naval and land attack on Fort Darling, but McClellan declined, preferring to wait until after he should have crossed the Chickahominy. The Confederate authorities were so much impressed with the gravity of the situation, when they heard that the fleet was ascending the river, that the government archives were shipped to Columbia, S. C., and the public funds were kept on cars ready for transportation.

The Confederate defense at Fort Darling was looked upon as the salvation of the Confederate capital. Strong works were now constructed by the Confederates on Drewry's Bluff and on the opposite side of the river, and to the end of the war they barred advance on Richmond by water. Elaborate works were constructed to defend the city from the land side. On 31 May Gen. J. E. Johnston, commanding the Confederate army, advanced from his works around Richmond and attacked McClellan. The battle continued two days, at the end of which the relative positions of the two armies were unchanged. (See **FAIR OAKS, BATTLE OF.**) On 25 June McClellan, in view of a general advance, threw forward a part of his force toward Richmond, gaining some ground, but Gen. R. E. Lee, commanding the Army of Northern Vir-

ginia, assumed the offensive on the 26th by crossing the Chickahominy and attacking McClellan's right, forcing McClellan to retreat to Harrison's Landing, on James River, after a series of hard-fought, bloody battles. (See **PENINSULA CAMPAIGN OF 1862; SEVEN DAYS' BATTLES.**) Richmond now had some respite. Lee invaded Maryland, and upon his return defended Richmond on the line of the Rappahannock, from which Burnside, in December 1862, and Hooker, in April 1863, unsuccessfully endeavored to force him. Lee again assumed the offensive and marched northward for an invasion of Maryland and Pennsylvania, leaving but a small force at Richmond, and Hooker, 10 June, proposed to march immediately upon the city, capture it, and then send the disposable part of his force to any threatened point north of the Potomac, but the proposition was negatived by Gen. Halleck, and Hooker was informed by President Lincoln that Lee's army, and not Richmond, was his true objective. On 14 June Halleck ordered Gen. Dix, commanding at Fort Monroe, to send an expedition to threaten Richmond, and destroy the railroad bridges over the South and North Anna rivers. Dix drew troops from Suffolk and Norfolk, and on the 24th Col. Spear, with about 1,200 men of the 11th Pennsylvania, 2d Massachusetts and 12th Illinois cavalry, was sent by water up York River, landed at White House on the 25th, marched through Hanover Court House, and on the 26th attacked and captured about 100 men of the 44th North Carolina at the bridge of the Virginia Central Railroad over the South Anna, burned the bridge, and returned to White House on the morning of the 27th. Upon Spear's return Dix organized an expedition of 10,000 men, under Gen. Getty, to destroy the bridge of the Fredericksburg and Richmond Railroad over the South Anna, and an expedition of 6,000 men and 14 guns, under Gen. Keyes, to threaten Richmond by seizing Bottom's bridge over the Chickahominy. Both expeditions moved from White House on 1 July. Keyes failed to accomplish anything, being held in check by a small force under Gen. D. H. Hill. Getty, preceded by Spear's cavalry, marched from White House to Hanover Court House, which he occupied on the 4th, his advance reaching the bridge over the South Anna late in the day and making an attack, which was repulsed by Gen. John R. Cooke, who had about 4,000 men. Gen. Foster, who was in command of Getty's advance, destroyed some of the railroad track, and during the night was recalled to Hanover Court House. The depot and track at Ashland Station were destroyed, and on the 5th Getty took up the return march to White House, which was reached on the 7th, his loss being 16 killed, wounded, and missing. Dix returned to Fort Monroe and sent part of his command to the Army of the Potomac.

After the Gettysburg campaign (see **GETTYSBURG, CAMPAIGN AND BATTLE OF**), Gen. Lee fell back beyond the upper Rappahannock, and Gen. Meade followed. Meade was forced back to Centreville, and, renewing the offensive, pushed Lee beyond the Rappahannock and then beyond the Rapidan. Meade now essayed an advance on Richmond by passing Lee's right, but was checked at Mine Run (q.v.), 28-9 Nov. 1863.

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On the morning of 6 Feb. 1864 Gen. I. I. Wistar, with 2,200 cavalry and 4,000 infantry, left Williamsburg to make a dash on Richmond and release the Union prisoners there. The cavalry advance arrived at Bottom's bridge, on the Chickahominy, about 13 miles from Richmond, before daylight of the 7th, and found the Confederates in force under Gen. Eppa Hunton, and reinforcements coming up by railroad from Richmond. A deserter from the Union army had given information of the proposed movement, troops had been sent from Richmond, Bottom's bridge taken up, and the fords obstructed. The cavalry charged one of the fords and was repulsed by canister fire with some loss. and Wistar desisted from further effort and returned to Williamsburg. To cover this movement and divert Lee's attention from it, the cavalry and two corps of the Army of the Potomac made a demonstration on the 6th upon Lee's army at Morton's Ford, the demonstration continuing on the 7th, with considerable loss. Later in the month Gen. Kilpatrick made a movement on Richmond which resulted in a lamentable failure. (See RICHMOND, KILPATRICK'S EXPEDITION TO.)

The next and final campaign against Richmond was conducted by Gen. Grant, beginning in May 1864. With the Army of the Potomac he advanced from the north, while Gen. Butler, with the Army of the James, crossed to the south side of James River and marched up its right bank. Butler was defeated at Drewry's Bluff (q.v.), 16 May, and confined to his intrenchments at Bermuda Hundred (q.v.). The Army of the Potomac began the campaign by the battle of the Wilderness (q.v.), 5-7 May, and on the 9th Gen. Sheridan set out on his raid, elsewhere described. (See RICHMOND, SHERIDAN'S RAID ON, and the BATTLE OF YELLOW TAVERN.) Grant continued his campaign in a series of sanguinary battles, and after the bloody repulse of Cold Harbor (q.v.) he abandoned the campaign north of the James, crossed to the south side of the river, 14-16 June, and invested Petersburg and Richmond from that side. (See PETERSBURG, MILITARY OPERATIONS AGAINST.) The siege began on 19 June 1864, and continued until 2 April 1865, when Petersburg was assaulted and taken, and that night Richmond was evacuated, the Union troops under Gen. Weitzel occupying it 3 April.

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Richmond, Borough of. See NEW YORK CITY.

Richmond College, located at Richmond, Va. It was founded in 1832 by the Baptists under the name of the Virginia Baptist Seminary; the name was changed to Richmond College in 1840. The college was closed during the Civil War; the buildings were used as a hospital by the Confederates, and as barracks by the Federals after their occupation of Richmond. The equipment was largely destroyed and much of the endowment rendered worthless, but the college was reopened in 1866, a new endowment was obtained, and it has since then had a prosperous career and has taken a leading part in Southern educational life. The work of the collegiate department is divided into nine schools, as follows: (1) Latin language and literature; (2) Greek language and literature;

(3) French and German; (4) English language and literature; (5) mathematics; (6) physics; (7) chemistry; (8) philosophy; (9) history. Courses are elected in accordance with the group system, there being three groups; the degree of A.B. and B.S. are conferred; and A.M. for graduate work. There is also a School of Law, which confers the degree of B.L. Women were admitted to the college in 1898. The campus contains 13 acres; the ground and buildings in 1910 were valued at \$600,000; the library contained 15,000 volumes, and the annual income in 1910 amounted to more than \$100,000. The students numbered 343, and the faculty 28.

Richter, rin'ter, Adrian Ludwig, German painter and designer: b. Dresden 28 Sept. 1803; d. there 19 June 1884. His father, Carl August Richter, the well-known copperplate engraver, was his first teacher, as he was his father's collaborateur in the production of landscapes in black and white. In 1820 he accompanied Prince Narischkin in a journey through France as draughtsman to illustrate that nobleman's travels; subsequently he spent three years, ending 1826, in Italy. He next applied himself to study the masters of the North Holland School, and chose J. Schnorr as his especial model and standard of excellence. Returning to Germany he was appointed in 1828 to a position in the School of Design at Meissen, which he held for 10 years, meanwhile acquiring a popular reputation as illustrator of 'The Vicar of Wakefield' and 'Popular Books of Germany.' He inaugurated an epoch in German illustrative art by his sympathetic interpretation of common life in Germany, his tender humor and refined fancy. While he drew on wood for book illustration, he also executed numerous etchings, mostly of Italian landscapes. The most important of his landscapes in oil, which, however, are marred by a certain coldness of treatment, are: 'Storm on Mount Gerone' (1830, in the Museum, Frankfurt-on-Main); 'Harvest Time on the Roman Campagna' (1833, Leipsic Museum); 'Schreckenstein near Aussig'; 'Landscape in the Riesen Mountains'; etc. After working for some years as professor of landscape painting in the Dresden Academy, he retired in 1876 on a pension provided by the German emperor. Consult: his autobiography, 'Lebenserinnerung eines deutschen Malers' (1855); Hoff, 'Adrian Ludwig Richter, Maler und Radierer' (1877).

Richter, Gustav, German painter: b. Berlin 31 Aug. 1823; d. there 3 April 1884. He studied under Eduard Holbein in Berlin and Cogniet at Paris, also studied at Rome. He was professor of the Berlin Academy and honorary member of the academies of Munich and Vienna. His first work to attract attention was the 'Raising of Jairus' Daughter' (1856). In 1864 he received the Grand Medal at Berlin; other medals have been conferred on him at Paris, Brussels, Vienna, and Philadelphia. His works are reproduced in vivid colored chromos. He painted many European celebrities, and of Americans a notable portrait of George Bancroft, the historian.

Richter, Henry Joseph, American Roman Catholic bishop: b. Neunkirchen, Oldenburg, Germany, 9 April 1838. He came to the United States in 1854, studied at Saint Xavier's College, New York, at Mount Saint Mary's Sem-

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inary, Cincinnati, and in 1860 entered the American College at Rome, where he was graduated in 1865. He was ordained in that year, was vice-president and professor of dogma, philosophy, and literature at Mount Saint Mary's Seminary in 1865-70, and in 1870-83 was rector at Saint Lawrence and chaplain of Mount Saint Vincent Academy. In 1883 he was consecrated first bishop of Grand Rapids.

Richter, Jean Paul Friedrich, generally known as **JEAN PAUL**, German author: b. Wandsiedel, near Baireuth, Bavaria, 21 March 1763; d. Baireuth 14 Nov. 1825. He was educated at Leipsic, and became a tutor and schoolmaster. In 1794 he turned from this to a general literary activity. The prince-primate Dalberg gave him in 1809 an annual pension of 1,000 florins, continued by the king of Bavaria. The fantastic quality of his genius was at first disconcerting, but gradually, says Carlyle, he became considered "not a strange crack-brained mixture of enthusiast and buffoon, but a man of infinite humor, sensibility, force, and penetration." His style is perhaps one of the most barbarous of mediums, and his books are quite without structure. His humor, however, is genuine, though frequently clumsy. He affected boldly to despise all literary proportion and technique, and is recompensed by having the bulk of his work pronounced difficult or unreadable. Yet scattered through his writings are the best of aphorisms and some of the most finely imagined passages in German literature. These may serve to account for the interest Carlyle and De Quincy took in him. Outside of Germany he has not been greatly read, though there are various English renderings of his volumes, such as 'Walt and Vult' by Lee (1846); 'Titan' by Brooks (1863); 'Flower, Fruit, and Thorn Pieces' by Ewing (1877); and 'Levana' by Wood (1887). His first novel, 'Die unsichtbare Loge' ('The Invisible Lodge') appeared in 1793. It was followed by 'Hesperus' (1794); 'Biographische Belustigungen unter der Gehirnschale einer Riesin' ('Biographical Recreations under the Skull of a Giantess,' 1796); 'Leben des Quintus Fixlein' (1796); 'Blumen, Frucht und Dornenstücke' ('Flower, Fruit, and Thorn Pieces,' 1796); 'Der Jubelsenor' ('Parson in Jubilee,' 1797); 'Das Kampaner Thal' (1797); 'Titan' (1800); 'Flegeljahre' (translated by Carlyle, 'Wild Oats,' 1804). The two last are regarded as among his best productions. 'Das heimliche Klaglied der jetzigen Männer' appeared in 1801; 'Dr. Katzenberger's Badereise' (1809); 'Des Feldpredigers Schmelzle Reise nach Flätz' (1809); 'Leben Fibels' (1812); 'Der Komet, oder Nicolaus Markgraf' (1820-2); 'Die Vorschule der Aesthetik,' his first important philosophical work, appeared in 1804, followed by 'Levana, oder Erziehungslehre' (1807), a work on education. Further titles are: 'Friedenspredigt' (1808); 'Dämmerungen für Deutschland' (1809); 'Mars und Phöbus' Thronwechsel im Jahr 1814' (1814); 'Politische Fastenpredigten' (1817). A collection of his works, 'Sämmtliche Werke,' edited by him before his death, was published in 65 volumes (1826-38). 'Der Papierdrache,' his last work, was published in 1845. Consult Spazier, 'Jean Paul Friedrich Richter, ein biographisches Commentar zu dessen Werken' (1833); Carlyle's two essays on Richter; Förster, 'Derkwürdigkeiten

aus dem Leben Richters' (1863); and Nerrlich, 'Jean Paul und seine Zeitgenossen' (1889).

Richthofen, rīht'hōf-ən, Ferdinand, BARON VON, German geologist: b. Carlsruhe 5 May 1833; d. Berlin 7 Oct. 1905. He was educated at the universities of Breslau and Berlin; and went to Austria in 1856 to study the geology of Tyrol, Siebenbürgen and northern Hungary. In 1860 he joined a Prussian expedition to the East and spent 12 years in China, Japan, Siam, Java, the Philippine Islands, Formosa, California, and Nevada. Returning to Europe in 1872 he accepted professorships at Bonn, Leipsic, and Berlin, successively. He published 'China, Ergebnisse eigener Reisen und darauf gegründeter Studien' (1877-83), and the following which have appeared in English: 'The Comstock Lode' (1865); 'Principles of the Natural System of Volcanic Rocks' (1867); 'Letters to the Shanghai Chamber of Commerce' (1869-72).

Rich'wood, Ohio, village in Union County; on the Erie railroad; 34 miles northwest of Columbus. It was settled in 1832, and its growth during the first 30 years was slow; since 1870 it has become the second town of the county in size and importance. It is the centre of an agricultural region; contains flour and planing mills, tile mills, and several large grain elevators, and has a considerable trade. It has a public high school with a school library. Pop. (1910) 1,782.

Ricimer, rī-sī-mēr, Roman general of the 5th century A.D.; d. 472. He was a barbarian, and received his training under Aëtius. For a long time he was "kingmaker" in the West. He deposed Avitus, and elevated successively Flavius Anitus (454-6), Majorianus (457-61), Libius Severus (461). After Libius' death, he himself ruled for a time as Patricius, until in 467 the danger of a Vandal invasion compelled an alliance of East and West, and the elevation of Procopius Anthemius. Ricimer later grew openly hostile to the monarch, whom he murdered 11 July 472 during a sack of Rome. He then made Olybrius emperor, and died soon afterward.

Rickards, rīk'ardz, Marcus Samuel Cam, English poet and naturalist: b. Exeter 28 April 1840. He was educated at Oxford, admitted a solicitor in 1862, and practised for many years in Bristol. In 1876 he took priest's orders in the English Church, was curate of Holy Trinity at Clifton, near Bristol, till 1889, and since that date has been vicar of Twigworth, Gloucestershire. Among his many published works, mainly in verse, are: 'Creation's Hope' (1890); 'Poems of Life and Death' (1895); 'Poems of a Naturalist' (1896); 'Musings and Melodies' (1902).

Rickets, a disease of children in which there is an affection of the general nutrition of the whole body, dependent chiefly upon improper feeding and want of fresh air and exercise. The disease commonly appears after the age of nine months and before that of two years, producing its most obvious effects on the growth of the bones. It is characterized by enlargement of the head, prominent forehead, projecting breast-bone, flattened ribs, big belly, and emaciated limbs, with great debility. The bones and spine of the back are variously distorted. Nature fre-

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quently restores the general health, and leaves the limbs in a state of distortion. In the treatment of rickets tonic medicines, the cold bath, etc., are beneficial. The child should be kept clean and dry, regularly exercised, and allowed to enjoy a pure bracing air, that of the seaside being specially beneficial. The food should be nutritious and easily digestible.

Ricketson, rik'ët-sôn, **Walton**, American sculptor: b. New Bedford, Mass., 27 May 1839. He took up sculpture in 1870, and has since produced portrait busts of Bronson Alcott, Louisa M. Alcott, Thoreau, and George William Curtis, besides intaglios and bas-reliefs.

Ricketts, rik'ëts, **James Brewerton**, American military officer: b. New York 21 June 1817; d. Washington, D. C., 22 Sept. 1887. He was graduated from West Point in 1839, served in the Mexican War, where he was engaged at Monterey and at Buena Vista, was promoted captain in 1853, and fought in the Seminole War in Florida. He afterward served on the Texas frontier until the outbreak of the Civil War, when he assisted in the defense of Washington and the capture of Alexandria. He participated in the first battle of Bull Run, and was brevetted lieutenant-colonel and brigadier-general of volunteers. He commanded a division at Chantilly, South Mountain, and Antietam, in 1863 he received promotion as major of artillery in the regular army, was in command of a division in the Richmond campaign, and fought in the engagements from the battles of the Wilderness to the investment of Petersburg. In 1864 he served under Sheridan in the pursuit of Early's army. He was brevetted major-general in the regular army in 1865, and in 1865-6 was in command of a district in Virginia. He was mustered out of the volunteer service in 1866, and in 1867 retired from active duty.

Rickman, rik'man, **Thomas**, English architect: b. Maidenhead, Berkshire, 1776; d. March 1841. He developed a taste for architectural drawing, and having sent in a design for a church that proved successful in a government competition, he settled at Birmingham as an architect. He built a number of Gothic churches and chapels in Birmingham; Hampton, Lucy, Bristol, Preston, Carlisle, etc., many country houses, and the new buildings of St. John's College, Cambridge. He is the author of 'Attempt to Discriminate the Styles of Architecture in England from the Conquest to the Reformation' (1817).

Rico, ré'kō, Colo., town, county-seat of Dolores County; on the Rio Grande Southern railroad; 140 miles southwest of Leadville. The first settlement was made in 1867 and a new settlement in 1877, both by mining prospectors; the town was incorporated in 1879, and became the county-seat on the organization of the county in 1881. It is in a region rich in gold, silver, copper, and iron, and the chief industry is the mining and milling of these ores. The town contains a bank with a capital of \$50,000; and the county court-house. It has a graded public school. The government is vested in a mayor, elected annually, and a council of six members, three elected each year. Population in 1910, 1,208.

GEORGE H. HUTT,
Editor 'Rico News.'

Ricord, rê-kôr, **Philippe**, French physician: b. Baltimore, Md., 10 Dec. 1800; d. Paris, France, 22 Oct. 1889. He went to Paris in 1820, where he was granted his medical degree in 1826, practised in the provinces for two years, and on his return to Paris passed the Concours examination, and was appointed a surgeon at the Pitié Hospital. In 1831 his lectures in surgery secured his appointment as surgeon-in-chief at Hôpital des Veneriens du Midi, an office he continued to fill until 1860, when he resigned and engaged in private practice. In 1862 he was appointed physician in ordinary to Prince Napoleon, and in 1869 consulting surgeon to Napoleon III. He was made commander of the Legion of Honor in 1860, and for his services in the ambulance corps during the siege of Paris was made grand-officer of the Legion in 1871. He was the author of various valuable surgical treatises, and invented several surgical instruments.

Riddell, rid-dël' or rid'l, **Charlotte Eliza Lawson Cowan**, English novelist: b. 30 Sept. 1832. She was the daughter of a high sheriff of Carrickfergus, Ireland, and was married to J. H. Riddell of Staffordshire in 1857. Her earliest novel was 'The Ruling Passion' (1858); and among her many later fictions are 'George Geith,' one of her best known works (1865); 'Maxwell Drewitt' (1865); 'Far Above Rubies' (1868); 'The Senior Partner' (1881); 'The Head of the Firm' (1892); 'A Rich Man's Daughter' (1897). Her stories are well constructed, wholesome tales, and have been popular in this country as well as in England.

Riddell, Mrs. J. H. See RIDDELL, CHARLOTTE ELIZA LAWSON COWAN.

Riddle, rid'l, **Matthew Brown**, American theologian: b. Pittsburg, Pa., 17 Oct. 1836. He was graduated from Jefferson College, Pa., in 1852, and from the New Brunswick Theological Seminary in 1859. He was adjunct professor of Greek at Jefferson College in 1857-8, was pastor of the Dutch Reformed Church, Hoboken, N. J., 1861-5, and of the Second Reformed Church, Newark, N. J., 1865-9. In 1871-87 he occupied the chair of New Testament exegesis at Hartford Theological Seminary, Conn., and since 1887 has filled that chair at the Western Theological Seminary, Allegheny, Pa. He was a member of the American Committee for New Testament revision, an editor of the Standard edition of the Revised Version, and was a revising editor on the Standard American Revised Version of the New Testament (1901). He was one of the editors of Lange's 'Commentary'; 'International Commentary'; 'International Revision Commentary'; and Myer's 'Commentary'; edited Robinson's 'Greek Harmony of the Gospels' (1885); Vols. VII., VIII., 'Ante-Nicene Fathers' and Vols. VI., X., 'Nicene and Post-Nicene Fathers' (1886).

Riddle, any sentence or composition with a double or veiled meaning, which is propounded with a view to the discovery of that meaning, which is designedly obscured by the terms of the riddle. A riddle may either have an apparent sense which serves as a disguise to the real one, or it may be in the form of a question, the terms of which do not directly indicate the na-

ture of the answer required. Riddles naturally divide themselves into two classes: plays upon words, which are otherwise called conundrums; and allegorical or fanciful descriptions of or allusions to the subject on which the riddle is founded. The latter is called an enigma. It is the more ancient and serious form of the riddle. Enigmas, or dark sayings, were frequently used by the ancients to disguise important truths, which it was not deemed safe or advisable that every one should know. Kings sent enigmas to each other, ambassadors delivered their messages in this form, and the oracles of the gods were frequently conveyed in the form of an enigma. In modern times serious enigmas have been elaborated in prose and verse, particularly the latter, in all civilized languages. They are in general mere elaborate trifling, and are commonly as dull as they deserve to be.

Among the most celebrated examples of ancient riddles is that propounded by the Sphinx, and answered by Œdipus, What animal is that which goes on four feet in the morning, on two at midday, and on three in the evening? The answer is Man, because he goes on all fours as a child, on two feet as a young man, and with a staff in old age. The punning variety of riddle, though sometimes indulged in by the Greeks and Romans, is comparatively of modern growth. It is a great favorite in festive gatherings of juveniles. Sometimes strings of puns are linked together with considerable ingenuity in the more complex riddles of this description, as in the following instance: What wind does a hungry sailor like best? One that blows fowl and chops, and then comes in little puffs. The earliest collection of riddles known to have been published is entitled 'Demands Joyous,' printed in 1511. The first French collection was published in Paris by Gille Beys in 1582. See also ENIGMA.

Rideau (rê-dô') **Canal**, a Canadian canal constructed between Kingston on Lake Ontario and Ottawa as a through waterway by means of the River Ottawa to Montreal, the Saint Lawrence route being interrupted by rapids. Canals have since been built along the Saint Lawrence to avoid these, and the Rideau is now little used.

Rideing, rid'ng, **William Henry**, American editor: b. Liverpool, England, 17 Feb. 1853. He came to the United States and lived in Chicago until 1870, after which he was engaged in journalism in various American cities. Since 1881 he has been associate editor of the 'Youth's Companion,' and in 1887-99 was associate editor of the 'North American Review.' He has published: 'Scenery of Pacific Railways' (1878); 'Thackeray's London' (1885); 'In the Land of Lorna Doone' (1895); 'At Hawarden with Mr. Gladstone' (1896); 'How Tyson Came Home' (1904); etc.

Riders, in national or state legislation, the additional provisions of a bill under the consideration of a legislative assembly, having little connection with the subject-matter of the bill. Sometimes riders are attached to important bills, in order to gain the chance of passage, since by themselves they are likely to incur an executive veto, but as a part or proviso of an important bill they are absorbed in the main subject, and so dodge the "veto" and the "table." It has been proposed frequently that the Constitution of the United States be so amended that the

President could veto single objectionable items without affecting the main purpose of bills.

Ridge, ridj, **Major**, Cherokee chief: b. Highwassee, present State of Georgia, about 1771; d. Cherokee reservation 22 June 1839. He became a councillor and one of the leaders of the Cherokee nation. He favored the deportation of the Cherokees from the Georgia reservation to one westward of the Mississippi, and was murdered, presumably, by some of the opposing party.

Ridge, **William Pett**, English novelist: b. Chartham, Kent. He was educated at the Birbeck Institute in London. He began to write in 1890, and among his published works are: 'The Second Opportunity of Mr. Staplehurst' (1896); 'A Son of the State' (1889); 'A Breaker of Laws' (1900); 'Outside the Radius' (1900); 'Lost Property' (1902).

Ridgefield, ridj'feld, Conn., town in Fairfield County; on the New York, New Haven & Hartford railroad; about 60 miles northwest of New York, and 13 miles north by west of Norwalk. It is in an agricultural region, and is a favorite resort for residents of New York. The chief industries which contribute to the prosperity of the town are farming, dairying, the grinding of feldspar, and the manufacturing of ice-cutting tools. The most prominent public building is the public library, presented to the town by James Morris of New York, in memory of his wife, Elizabeth W. Morris. There are four churches, good public schools, and one private school. The National Bank has \$25,000 capital; the savings bank has \$592,268.52 deposits. The government is administrated by a board consisting of a warden and burgesses, six members, elected annually in May. Pop. (1900) 2,626; (1910) 3,118.

W. A. WHITE,
Editor 'Ridgefield Press.'

Ridge'town, Canada, town in the County of Elgin, Province of Ontario; on the Michigan Central railroad; about eight miles from Lake Erie and 65 miles east of Windsor. It is in an agricultural region, and has some manufacturing interests.

Ridgeville, ridj'vil, Ind., town in Randolph County; on the Mississinewa River, and on the Pittsburg, C., C. & St. L. and the Grand Rapids & Indiana R.R.'s.; about 60 miles south of Fort Wayne, and 90 miles northeast of Indianapolis. It is in a fertile agricultural region, and is the trade centre for the northern part of the county. It has several industries connected chiefly with farm products and stock raising. It has good public schools, several private schools, and a public library. Pop. (1910) 1,178.

Ridge'wood, N. J., village in Bergen County; on the Erie railroad; about 22 miles north of New York. The railroad divides the village into eastern and western sections. The village is in a residential locality; the western side is built up with fine residences, most of them the homes of men doing business in the city. The eastern section of the village spreads out into the Paramus Valley, through which flows the Saddle River. In this part are substantial dwellings with extensive grounds. There are no manufactories. The business blocks and fraternal society buildings are mostly of limestone and pressed brick.

There are nine churches, public schools, and one private school for boys. Located here is the House of Divine Providence for Incurable Patients, in charge of Sisters of Charity. The water supply is obtained from artesian wells. The roads in the vicinity are excellent, and the scenery in general, together with the numerous groves and small streams, make it a most charming locality. In the vicinity are many points of historic interest, their histories dating back to pre-Revolutionary days. Pop. (1890) 1,047; (1900) 2,685; (1910) 5,416.

Ridgway, rĭd'wā, Robert, American naturalist: b. Mount Carmel, Ill., 2 July 1850. He was zoologist to the United States geological exploration of the fortieth parallel under Clarence King in 1867-9, and since 1880 has been curator of the division of birds in the National Museum at Washington. He was one of the founders in 1883 of the American Ornithologists' Union, of which he later became president. He served as a member of the committee at the first International Ornithological Congress at Vienna in 1885, and of that at Budapest in 1891. He is author of: 'A Nomenclature of Colors for Naturalists' (1886); 'Manual of North American Birds' (1887); 'Birds of North and Middle America' (1901-2); etc.

Ridgway, Pa., borough, capital of Elk County; on the Clarion River, and on the Buffalo, R. & P. and the Pennsylvania R.R.'s; about 150 miles northeast of Pittsburgh and 115 miles southeast of Erie. It is in a region devoted mainly to lumbering and agriculture. The chief industrial establishments are lumber mills, sash, door, and blind factories, flour and grist mills, machine shops, engine and boiler works, and dry kilns. There are other manufactories whose products are mining materials, proprietary medicines, and tobacco products. The educational institutions are public and parish elementary schools, a public library, and a private business school. Pop. (1910) 5,408.

Riding and Driving. See HORSES, RIDING AND DRIVING.

Ridley, rĭd'li, Nicholas, English ecclesiastic and martyr: b. about 1500; d. Oxford 16 Oct. 1555. He was graduated from Cambridge in 1521-2, later studied at the Sorbonne, Paris, and at the University of Louvain. Returning to Cambridge as proctor to the university, as such he advocated the claims of King Henry VIII. to the supreme ecclesiastical jurisdiction in the realm. Through the patronage of Archbishop Cranmer he became one of the king's chaplains; in 1540 he became master of Pembroke Hall, in 1541 canon of Canterbury, and in 1545 an additional canonry of Westminster was conferred upon him. In 1547 he was elevated to the see of Rochester. In 1550, on the deprivation of Bonner, Ridley was made bishop of London, and distinguished himself by his tempered zeal in favor of Protestantism, and especially by his liberality and kindness toward the family of his predecessor. In 1553 in a sermon before Edward VI. he made an appeal for the destitute London poor, and as a result of subsequent conferences the king and corporation of London determined to build Christ's Hospital, St. Thomas' Hospital, and Bethlehem Hospital. On the death of Edward he was induced to listen to those who

attempted to secure the Protestant ascendancy by placing the Lady Jane Grey upon the throne. The defeat of this scheme, the active part he had taken in the establishment in the new discipline and the construction of the liturgy, together with his connection with Cranmer, marked Ridley out as one of the most prominent opponents of Queen Mary. He was arrested and sent to the Tower 20 July 1553. In the spring of 1554 he was removed to Oxford, and being brought before the royal commissioners and refusing to recant he was excommunicated. His further trial progressed slowly. The next year parliament passed penal laws against heretics and under these he was summoned to trial. His condemnation followed upon his admitting the truth of the principal charges against him, and he was burnt at the stake in company with Hugh Latimer.

Rid'path, John Clark, American educator and historian: b. Putnam County, Indiana, 26 April 1840; d. New York 1 Aug. 1900. He was graduated from Asbury University, Indiana, in 1863, and in 1864 was appointed principal of the academy at Thornton, Ind. In 1866 he was superintendent of public instruction for Lawrenceburg, Ind., and in 1867-9 professor of languages at Baker University, Baldwin City, Kan. In 1869 he was appointed to the chair of English at Asbury, and in 1879 became vice-president of the university. The endowment of \$2,000,000 bestowed upon the university by Mr. De Pauw, was secured largely through Ridpath's efforts, and under his management it received its new name of De Pauw. After his resignation from the university he devoted himself to literature. He was one of the editors of the 'People's Cyclopædia' (1881), and published 'Academic History of the United States' (1874-5); 'Popular History of the United States' (1877); 'Life of James A. Garfield' (1882); 'Cyclopædia of Universal History' (1880-4); 'Great Races of Mankind' (1893); 'Life and Times of Gladstone' (1898); 'History of the United States' (1900); etc.

Riedesel, rē'dē-zēl, Frederica Charlotte Louisa (VON MASSOW): b. Brandenburg 1746; d. Berlin 29 March 1808. She was the wife of Baron Riedesel (q.v.), and accompanied her husband to America. After Burgoyne's surrender she resided for a year at Cambridge, Mass., where a street has since been named in her honor; and later at Charlottesville, Va. She wrote graphic descriptions of the campaign and subsequent events, published after her death by her son-in-law, Count von Reuss, and translated inadequately into English in 1827 ('Letters and Memoirs Relating to the War of American Independence, and the Capture of the British Troops at Saratoga'), and worthily by W. L. Stone in 1867 ('Letters and Journals Relating to the War of the American Revolution').

Riedesel, Friedrich Adolph, FREIHERR ZU EISENBACH, German soldier: b. Lauterbach, Rhine Hesse, 3 June 1738; d. Brunswick 6 Jan. 1800. He studied at the Marburg law school, but before the completion of his course enlisted in a regiment of Hessian infantry as vice-ensign, and soon afterward went to England with his regiment, which had been made part of the British army, and was billeted on a town near London. There he became fairly pro-

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ficient in English. On the outbreak of the Seven Years' war in 1756, the regiment was summoned to Germany, and Riedesel was assigned to the immediate staff of Duke Ferdinand of Brunswick. Shortly after the outbreak of the American Revolution, England negotiated with several of the petty sovereigns of Germany for some 20,000 troops. Of these about 4,000 were from Brunswick. Riedesel was promoted major-general and placed in command of the Brunswick contingent, and on 1 June 1776 he reached Quebec. A thorough disciplinarian, he practised his troops in the American mode of fighting, particularly in rapidity of firing, in which the Continentals were much more efficient. He accompanied Burgoyne (q.v.) on the ill-fated expedition of 1777, distinguished himself at Ti-conderoga, and at Hubbardton brought up reinforcements and dispersed the Americans. At Freeman's Farm 19 Sept. 1777, he saved the British from rout by arriving with his Brunswickers; and, after the action on 7 October, had his counsels prevailed, Burgoyne would probably have made a successful retreat to Canada. He was taken prisoner at Saratoga 17 October, exchanged in 1779, and in that year appointed to a command on Long Island. In 1783 he returned to Germany, in 1787 was promoted lieutenant-general, and in 1788 commanded the Brunswick portion of the army sent from Germany to Holland to assist the Stadtholder. From 1794 until his death he was commandant of the town of Brunswick. The 'Leben und Wirken des General-Lieutenants F. A. Riedesel, nebst vielen Original-Correspondenzen und historischen Aktenstücken,' by von Eckling, appeared in 1856. An abridged translation into English by W. L. Stone was published in 1868. It affords a most complete and accurate account of Burgoyne's expedition, as well as a clear view of contemporary affairs in Canada.

Riel, rê-él', Louis, Canadian insurgent: b. St. Boniface, Manitoba, 23 Oct. 1844; d. Regina, Northwest Territory, 16 Nov. 1885. He belonged to the Mitis race of Franco-Indians, and as protégé of Archbishop Taché, was educated at the Jesuit College at Montreal. In 1869 he took part in the protest raised by the native tribes against the establishment of Canadian authority in the territories lately acquired from the Hudson Bay Company, and was elected president of a provisional government established at Fort Garry. The rebellion was suppressed the next year by a force under Sir Garnet Wolseley and Riel fled from the territory. In 1873 he was elected to the Dominion parliament for Provencher, but was not permitted to take his seat, and after two subsequent re-elections a warrant of outlawry was issued against him and he was sentenced in 1875 to five years' banishment with forfeiture of political rights. In 1884-5 he headed a party of half-breeds in another insurrection, which was soon suppressed. Riel was taken prisoner, convicted of treason, and executed. See **RIEL'S REBELLION**.

Riel's Rebellion, or the Northwest Rebellion, was an outbreak of the half-breeds and Indians of the valley of the Saskatchewan, in the spring of 1885, promptly suppressed by the Canadian militia. For some time past discontent had been rife among the half-breeds, or metis, of that district, who feared that the surveying of the

country by the Dominion government and the government sales of land to incoming settlers would dispossess them of their homesteads. In June 1884 Louis Riel, the half-breed leader of the abortive outbreak of 1869-70, returned by invitation from Montana and put himself at the head of the movement. At a gathering at Saint Laurent, on the Saskatchewan, September 1884, a "Bill of Rights" was adopted asking that the half-breeds should receive the same grant of 240 acres per capita that had already been given (1870) to their kinsmen in the province of Manitoba. With this demand were coupled more extravagant pretensions to further reservations of land and grants of money. Various petitions had already been sent to the Dominion government in behalf of the half-breed claims. A commission had been appointed to consider them, but the whole matter aroused so little public attention in Canada that the news of the actual revolt in March 1885 came with alarming suddenness. On the 17th of that month the metis formed a provincial government, with Louis Riel (q.v.) as president, Gabriel Dumont as adjutant-general, and a numerous council. All obtainable stores were seized, supplies on the way to Prince Albert intercepted, and the telegraph wires cut. At the same time every effort was made to arouse the Indians of the Saskatchewan district, detachments of whom, under Beardy and One-Arrow, at once joined the rebels. The only forces immediately available to cope with the outbreak were about 500 mounted police, scattered in small detachments over the Northwest Territory, of whom some 200 men of all ranks were distributed between Prince Albert, Fort Carlton, Battleford, and Fort Pitt. The rebels demanded the surrender of Fort Carlton, a mounted police post on the North Saskatchewan, 40 miles above Prince Albert, held by Major Crozier with a handful of men. Crozier refused, and succeeded in communicating with Prince Albert, and obtaining a reinforcement of 40 volunteers. With the help of these he attempted (26 March) to secure the stores from Duck Lake, a post a few miles distant. Here occurred the first bloodshed of the rising. The rebels attacked Crozier near Duck Lake, and forced him to retire to Carlton with a loss of 12 killed and 12 wounded. The mounted police burned the fort at Carlton and retired to Prince Albert. The news of the fight at Duck Lake occasioned intense excitement throughout Canada. Immediate steps were taken to despatch an adequate force of militia to the northwest. General Sir Frederick Middleton, the commander-in-chief, was already on his way. On the 28th of March there was a general call to arms of the militia forces, picked troops from the different regiments being at once forwarded to the front. Various corps of scouts, rangers, cavalry, etc., were specially organized. Eighteen hundred troops started from Ontario and Quebec within six days of the call to arms, and within a month 3,000 men had been transported to the northwest and 1,500 raised in Manitoba and the territories. The area of operations was the valley of the Saskatchewan River, whose north branch runs from west to east through the district of the same name at a distance of about 200 miles north of the Canadian Pacific Railroad and roughly parallel with its course. On this river were the important posts of Prince Albert, Battleford, sit-

RIENZI

uated about 160 miles farther up the river, and Fort Pitt, also on the river, 120 miles northwest of Battleford. The main body of rebels had established themselves at Batoche, on the South Saskatchewan, a river flowing from the southwest to meet its confluent on a long V-shaped angle. Mustering his forces at Qu'Appelle and Swift Current, Middleton resolved to strike into the rebel territory in two columns. The main column, under Middleton, was to move northward on Clark's Crossing, a ferry station on the Saskatchewan about 40 miles by trail from Batoche. A second, under Lieutenant Colonel Otter, was to march from Swift Current (140 miles west of Qu'Appelle) to the relief of Battleford. A third force, gathered at Calgary, was to descend the route of the North Saskatchewan from Edmonton, thus reaching Fort Pitt. Meantime the position of affairs appeared extremely critical. Some 500 Indians in the neighborhood of Battleford had risen under Poundmaker, a Cree chief, laid siege to the stockade fort in which the whites had taken refuge, and plundered the stores of the town. Near Fort Pitt the Indians had also risen under Big Bear, and at Frog Lake, a post about 30 miles distant, on Good Friday (3 April), they plundered the stores and shot down nine persons in cold blood. The news of the massacre spread terror throughout the unprotected valley of the upper river, the settlers fleeing toward Edmonton. Many of the deserted houses were looted and burned. The advance was carried out with admirable success. The main column, the Royal Grenadiers, A Battery and other troops, traversing in forced marches 177 miles of prairie, struck the South Saskatchewan at Clark's Crossing. Advancing northwards down the river, they came upon the rebels strongly posted in a wooded ravine called Fish Creek, in which they had constructed rifle pits. A sanguinary contest ensued (23 April). The rebels, led by Gabriel Dumont, defended themselves stubbornly, but were ultimately dislodged. The loss of the militia was 10 killed and 40 wounded. The second column, under Otter, consisting chiefly of Queen's Own men, left Swift Current 13 April, and after a march of 202 miles successfully relieved the beleaguered fort at Battleford. From there Colonel Otter determined to strike at Poundmaker's reserve, against which he moved on 1 May, with a force of 325 men and three guns. They came upon the Indians in force at Cut Knife Hill, and after a severe engagement were compelled to retire on Battleford, with a loss of 8 killed and 14 wounded. At the same time General Strange, with the third division, marched from Calgary to Edmonton (2 May), and thence directed his forces against Big Bear. Meanwhile General Middleton decided to move forward against the main body of the half-breeds at Batoche. The advanced season rendered possible the navigation of the South Saskatchewan, down which the steamer Northcote, with supplies and munitions, was despatched to join Middleton's column. Batoche was invested by the militia on 9 May, and a four days' fight ensued. The rebels were entrenched in rifle pits along the banks of the river. During the first three days the fighting was desultory, Middleton using his artillery and throwing up earthworks in order to exhaust the ammunition of the half-breeds without unduly exposing his men. The Northcote, that was to

have aided in the attack, steamed down the river under a hot fire on the 9th, but its steering gear being disabled, it drifted past Batoche. On the fourth day a general charge of the militia resulted in a complete victory. The rifle pits and the village of Batoche were taken by storm and Riel and many of his council captured. Dumont escaped to the United States. The loss of the Canadian forces in the four days was 8 killed and 46 wounded; that of the rebels, 51 killed and 173 wounded. With the storming of Batoche the rebellion was virtually at an end. Poundmaker capitulated, and Big Bear fleeing to the north, though offering fight at Frenchman's Butte and Loon Lake, was ultimately captured (2 July). Riel was taken to Regina, where he was tried for treason-felony (July 1885). His counsel attempted to defend him on the ground of insanity, but the plea was unavailing, and he was sentenced to be hanged. Numerous petitions were sent from French Canada in favor of commutation of his sentence, with equally urgent petitions to the contrary from various parts of the Dominion. He was hanged at Regina 16 Nov. 1885, meeting his death with great fortitude. Eight Indians were shortly afterwards hanged at Battleford for complicity in the murders at Frog Lake, Fort Pitt and other places. Poundmaker, sentenced to three years' imprisonment, died in the Manitoba penitentiary. For further information consult the 'Official Report on the Suppression of the Rebellion,' Ottawa, 1886; 'Dominion Annual Register' (1885); 'Reminiscences Lieut.-Col. Bolton' (1886). STEPHEN LEACOCK.

McGill University.

Rienzi, rē-ēn'zē, Cola di, Roman popular leader; b. about 1313; d. 8 Oct. 1354. The son of an innkeeper, he became imbued with a passionate desire to re-establish the glory of ancient Rome on the ruins of the oligarchy under whose rule the people suffered. In 1343 he went to the Pope at Avignon, as the representative of the Roman people, and entreated him to return to Rome and end the misrule of the nobles. The Pope made Rienzi apostolic notary, and the latter returned to Rome, where he began the organization of a widespread movement for the overthrow of the aristocracy. On 20 May 1347, Rienzi summoned an assembly of the people at the Capitol, and there proposed a new constitution for the state, providing for the arming of the people and the garrisoning of the walls by them, the reform of justice and the equitable distributing of taxes. He became head of the new republic with the title of Tribune of the People, and by means of the popular levies forced the nobles to leave the city. Rienzi's plans included not merely the restoration of the municipal liberties of Rome, but the re-establishment of the ancient Roman state, and to that end he invited the Italian cities to send representatives to Rome for the consideration of the welfare of Italy. Though few cities responded, Rienzi, carried away by power and his own eloquence, caused himself to be crowned tribune 15 August, and bestowed the Roman citizenship on all inhabitants of Italy. The Pope's hostility, however, was aroused by Rienzi's vainglorious attempt to act as arbitrator in the dispute for the imperial throne that was then in progress, and he stirred up the Roman nobles against Rienzi. The nobles were defeated, but, Rienzi, dazzled by success, began to play the tyrant, and a second insurrection compelled him to flee the city (15

December). Later he went to Bohemia to secure the aid of Emperor Charles II. for the execution of his plans. The emperor handed Rienzi over to Pope Innocent VI., who, however, recognized how useful the tribune might be to him in crushing the Roman nobility and therefore sent him to Rome with Cardinal Albornoz in 1354. Rienzi's popularity was still great and he easily regained power; once more, however, he fell a victim to excess, perpetrated acts of outrage and oppression, and aroused the hatred of the people. An insurrection, stirred up by the nobles of the house of Colonna and Sarelli, broke out on 8 Oct. 1354. The mob stormed the Capitol, and Rienzi, seized as he was escaping in disguise, was murdered, and his body dragged through the streets. The career of Rienzi is the subject of one of Bulwer-Lytton's novels, 'Rienzi' (1835) and of Wagner's opera, 'Rienzi,' first produced at Dresden 20 Oct. 1842. Consult: Pappencordt, 'Cola di Rienzo und seine Zeit' (1841); Auriac, 'Etude historique sur Nicolo Rienzo' (1888); Rodocanachi, 'Cola di Rienzi' (1888).

Rienzi, The Last of the Roman Tribunes, a historical romance by Sir Edward Bulwer-Lytton, published in 1835. It is founded on the career of Cola di Rienzi (q.v.). Bulwer was so impressed with the heroism and force of character of his hero, that at first he meditated writing his biography, instead of a romance founded on his life. The story adheres very closely to the historical facts. Many of the situations and scenes are very strong. The treatment is epic rather than dramatic; and the splendid yet comfortless civilization of the Middle Ages, so picturesque and so squalid, so ecstatic and so base, is vividly delineated. Rienzi is also the subject of a once popular tragedy by Mary Russell Mitford, first published in 1828.

Riesengebirge, rē'zēn-gē-bēr'gē (the Giants' Mountains), part of the Sudetic chain, separating Silesia from Bohemia and Moravia, till it joins the Carpathians. It contains the loftiest mountains of the north or central parts of Germany. Some of the principal summits are Schneekoppe, 5,257 feet high; the Borenberg and the Grand Rad, each 5,156 feet high.

Riet-bok, rēt'bōk, the Dutch name of a South African species of antelope, *Antelope* (or *Tragelaphus*) *arundinaceus*. It is nearly five feet in length and about three feet high at the shoulder; the horns, about a foot long, are boldly annulated at the base. In color it is of a dull ashy gray, sometimes tinged with red on the upper parts and silvery-gray beneath. As its name (*riet-bok*, reed-buck) implies, it is found mostly among reeds or coarse long grass.

Riff, a name given to the coast districts of northern Morocco extending from Ceuta to the western frontier of Algiers, and forming a line of steep cliffs with few harbors. Its Berber inhabitants were formerly much addicted to piracy, and are still noted for smuggling.

Rifle. See SMALL ARMS.

Rifleman, or **Rifle Bird**, an Australian forest-bird (*Ptiloris paradisus*), closely related to the birds of paradise and so called because its colors and ornaments reminded the colonists of the old uniform of the British Rifle Brigade. The male is regarded as more splen-

did in plumage than any other Australian bird. The upper parts are velvety black, tinged with purple; the under parts velvety black, diversified with olive-green. The crown of the head and the throat are covered with innumerable little specks of emerald green of most brilliant lustre. The tail is black, the two central feathers rich metallic green. The female, as is often the case, is much duller colored than her mate. They obtain their insect food largely from beneath the loose bark of trees, about which they scramble like woodpeckers. Consult Newton, 'Dictionary of Birds' (1893-6).

Rifling. See ORDNANCE.

Rig Veda, rīg vā'dā, the oldest of the four Vedas, and therefore the oldest literary monument of the Indo-European races. The term Veda is the ancient Hindu Sanskrit word for knowledge, and the Vedas compose the great body of sacred scripture of the older Hindus, written in an ancient form of Sanskrit. The precise time of composition of the Vedas can not be determined, but it is probable that the Rig Veda was in course of composition as early as 1200 B.C., and some authorities contend that some of the verses must have been composed as early as 1500 B.C., the latest date of composition given for any of the verses being 600 B.C. It is known that the Rig Veda was composed by many different generations, and Max Müller believes that for a long period after its composition it was transmitted orally from one to another, and that it was not set down in writing until a much later date, since it contains no allusion to writing or writing materials. Of the four Vedas the Rig Veda is by far the most important, not only on account of its greater antiquity but also because of the information which it contains. The most authoritative writers state that the sacred hymns of the Rig Veda are repeated in a modified form in the Sama Veda, or chants, and in another form in the Yajur Veda, or ritual, while the fourth and latest of the Vedas, the inferior Atharva Veda, shows great modifications from the hymns of the Rig Veda, due to the introduction of superstitions, magic chants and vulgar charms. The hymns of the Rig Veda, in common with those of the three succeeding ones, are of four classes; the first and most important are the mantras, or sacred utterances, usually in metrical form; the next are the Brahmanas, or explanatory inspired utterances, being the oldest Indo-European bodies of prose; last come the Sutras, or rules of the sacrifice. The Rig Veda consists of 1,017 hymns or short lyric poems, with 10,580 verses. It is written in ten books, of which books ii.-viii. contain each the record of a single family or clan; book i., 15 collections, each attributed to a different poet-sage; book ix. glorifies the sacred drink "Soma," and book x. contains hymns supposed to have been composed by many different authors. The religion was nature worship, the chief objects of adoration being Agni, the god of fire, and Indra or Jupiter Pluvius, the cloud-compeller. The Hindu Triad had not yet arisen. The Rig Veda does not recognize the institution of caste. Beef was eaten. Women held a high position, and some of the hymns were composed by them. The rite of suttee was unknown; the conquest of Indra had

only begun, and the Ganges, incidentally mentioned, had not become a sacred stream. "The home of the Rig Veda," says Prof. Hopkins, of Yale University, "has been located in almost as many places as Paradise. Now it is by the Caspian Sea, now it is in Kandahar, but the Punjab is the favorite place, and quite naturally; for the poets are familiar with the Punjab, sing of it, talk of crossing its rivers, and in many ways show that they occupied, in part at least, the country stretching from Peshawar to Delhi." (See *SANSKRIT LITERATURE; VEDA.*) Consult: 'India Old and New: The Rig Veda,' by E. W. Hopkins (New York 1901); 'The Religions of India,' by the same author (Boston, 1895); and the translation by Arrowsmith (Boston, 1886) of A. Kaegi's 'Rigveda.'

Riga, *rē'gā*, Russia, capital of Livonia on the Dwina, seven miles from the Gulf of Riga, an inlet of the Baltic, is one of the principal seaports of the empire and ranks in trade next to Saint Petersburg and Odessa. Of the four parts into which it is divided, the old town alone preserves the Hanseatic features. It is characterized by high storehouses and spacious granaries; market place; other squares, and busy, winding streets. The Saint Peter's Church division of the town is the aristocratic quarter. The "Domkirche" (1204) contains one of the largest organs in the world. Saint Peter's Church has a tower 400 feet high. The Castle (1494-1515), built by Walter von Plettenberg, is a spacious building now occupied by the military authorities. Other places of more recent construction are: The Polytechnic, Exchange, municipal picture gallery, schools, gymnasiums and scientific and professional colleges, bonded warehouses and manufactories. At least half of the population is German, the German element predominating in the life of the city. There is an ever-increasing intellectual and commercial development. Riga is a great mart for timber from the vast White Forest, and the third city of Russia for exports, the chief of which are corn, hemp, oats, tallow, leather, tobacco, rugs, and feathers. Much of the interior trade is carried on by both rail and water communications.

Riga, Gulf of, Russia, an inlet on the east side of the Baltic Sea, 105 miles in length from north to south and about 60 in breadth. The islands of Ösel, Dagö, Mohn, and Worms, lie across the entrance. The chief river which falls into the gulf is the Dwina; seven miles above its mouth is the important commercial seaport of Riga (q.v.), after which the gulf is named.

Rigaud, *rē-gō*, Hyacinthe, French painter: b. Perpignan 20 July 1659; d. Paris 27 Dec. 1743. He arrived at Paris in 1681 and, acting under the advice of Lebrun, began to study portrait painting, taking Van Dyck for his model. In 1700 he became a member of the Academy, of which he was elected Professor in 1710 and Rector in 1733. His portraits are all extraordinarily successful as likenesses, his heads are full of character, and the figures have all the studied nobleness in attitude characteristic of the times; while he paints the gay costumes of the court with remarkable truthfulness and brilliancy. Among his most notable works in

the Louvre are the large portraits of Louis XIV. and Bossuet, of which latter a replica or copy is to be found in the episcopal palace at Meaux.

Rig'don, *Sidney*, Mormon leader: b. Allegheny County, Pa., 19 Feb. 1793; d. Friendship, N. Y., 14 July 1876. He was employed in a printing office in Pittsburg in 1812 when a manuscript entitled 'The Manuscript Found, or the Book of Mormon' was offered for publication by Samuel Spaulding (q.v.). The work impressed Rigdon so much that he made a copy of the manuscript before it was returned to the author who died soon after. In 1819 Rigdon became a Baptist preacher and in 1829 made the acquaintance of Joseph Smith, with whom (according to a story denied by the Mormons) he published 'The Book of Mormon,' transforming it by the addition of various pious phrases from an innocent historical romance into a new bible intended as the foundation of a new sect. He accompanied Smith to the West, assisted in founding the Mormon Church and became one of its presidents. He was one of the originators of the "new revelation" authorizing polygamy, and in 1844 on the death of Smith aspired to the leadership. He refused to acknowledge the authority of Brigham Young, was excommunicated, and returned to the East where he lived quietly until his death.

Rigg, *James Harrison*, English Wesleyan clergyman and educator: b. Newcastle-on-Tyne 16 Jan. 1821. He was educated at Kingswood School and in 1845 entered the Wesleyan ministry. He was a member of the London school board 1870-6; principal of the Westminster Training College 1868-1903; and a member of the Royal Commission on Education 1886-8. He edited the 'Quarterly Review' for 15 years and wrote: 'Principles of Wesleyan Methodism' (1850-1); 'The Churchmanship of John Wesley' (1868-78-86); 'Dr. Pusey: His Character and Life-work' (1883); 'Scenes and Studies in the Ministry of Our Lord' (1902); etc.

Riggs, *rĭgz*, *Elias*, American missionary and linguist: b. New Providence, N. J., 10 Nov. 1810; d. Scutari, Turkey, 17 Jan. 1901. He was graduated from Amherst in 1829, from Andover Theological Seminary in 1832, was ordained to the ministry and sailed for Greece as a missionary in the same year. He continued his work in Greece from 1832-8, in Smyrna from 1838-53, and from that time was engaged in Turkey. He returned to the United States once, in 1856, for the purpose of publishing his Armenian Bible, and while waiting for the completion of the work taught Hebrew in Union Theological Seminary in 1857-8. The remainder of his life was spent in Turkey. He translated the Bible into Bulgarian, Armenian, and Turkish, and published: 'Manual of the Chaldean Language' (1832); 'Grammar of the Modern Armenian Language' (1847); 'Grammar of the Turkish Language as Written in the Armenian Character' (1856); 'Notes on Difficult Passages in the New Testament' (1889); etc.

Riggs, *John Davis Seaton*, American educator: b. Washington, Pa., 29 Jan. 1851. He was graduated from the University of Chicago in 1878, after engaging in business in Rockford,

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Ill., in 1869-75. He was principal of the commercial department in Salt Lake Academy, Utah, in 1878-9, of the preparatory department in the old University of Chicago in 1879-86, and joint principal of University Academy, Chicago, in 1886-7. In 1887 he organized the Granville (now Doane) Academy of Denison University, Ohio, and was its principal until 1896, since when he has been president of Ottawa University, Kansas. He has published: 'In Latinum' (Cæsar) (1890); 'In Latinum' (Cicero) (1892); etc.

Riggs, Kate Douglas (Smith) (Wiggin), American author: b. Philadelphia 28 Sept. 1857. She was graduated at Abbott Academy (Andover, Mass.) in 1878; was the first to organize free kindergartens for the poor of the Pacific coast. She was married to G. C. Riggs in 1895, but continues to use the name "Kate Douglas Wiggin" as a literary signature. Her reputation as a humorist was made by the sketch 'The Birds' Christmas Carol' (1888), and has been well sustained by the cleverness in description and dialogue of her succeeding volumes, among them: 'The Story of Patsy' (1889); 'Timothy's Quest' (1890); 'Polly Oliver's Problem' (1893); 'Marm Lisa' (1896); 'Penelope's Progress' (1898); 'Penelope's Experiences in Ireland' (1901); and 'The Diary of a Goose Girl' (1902). She also edited the anthology 'Golden Numbers' (with N. A. Smith, 1902).

Righi, ré'gî. See **RIGI**.

Right is a claim or a title to anything whatever that can be enforced, or a claim to act, possess, or enjoy anything, or the use thereof, or it may exist in the nature of a privilege or power. Right has also been legally defined "as that which one has a legal claim to do; legal power; authority, immunity granted by authority." A legal right is one which is protected by law, and the means of protection is the remedy. The existence of a legal right implies the existence of legal remedy, for one does not exist without the other.

Right-handedness, the property or condition of being right-handed. The propensity in man to use the right hand in preference to the left is generally attributed to the lack of perfect symmetry in the body. If the body could be folded over from a medial line so that each organ of the one side should lie exactly on a corresponding organ of the other, the bodily structure would be highly fitted, in a mechanical sense, for the equal use of either limb, and ambidextral individuals would be the rule. The centre of gravity in the body is a little to the right of such a medial line. This makes the right side the heavier. From a series of experiments the greater weight has been estimated at about 15 ounces. On this fact is founded the mechanical theory of right-handedness, the predominance of the right hand over the left; or, more generally, of the limbs of the right side over those of the left. The three-lobed right lung is more capacious and receives more air during an inspiration than the two-lobed left lung. The liver during inspiration swings toward the right side, shifting the centre of gravity farther to that side. In violent muscular exertion there is more air proportionally inhaled by the lung of the side which

sustains the exertion. Under exertion of the right side the larger lung is better filled than the smaller, and the centre of gravity is removed till it is found in a line passing through the right foot; so that the right leg and foot afford a steadier basis of support than the left would do under similar circumstances. Through the greater use of the right lower limb the right upper limb comes to be preferred. In the case of a light weight, slung on the arm, the equilibrium of the body is better maintained by carrying it on the left side. If the weight be a heavy one, borne on the left shoulder, the burden is really being supported very much by the right limb, owing to the natural curve of the body toward the right side, while sustaining the pressure.

In a very few cases left-handedness has been found to accompany transposition of the viscera. But cases of genuine left-handedness far exceed in number such instances of transposition. Ferrier's researches have proved that when we see with the right eye we see with the left side of the brain. Hereditary left-handedness may be due to the greater development of the right side of the brain. "It is practically certain," says Bastian, "that the great preponderance of right-handed movements in ordinary individuals must tend to produce a more complex organization of the left than the right hemisphere."

In the evolution of man right-handedness has probably been a late acquisition. The oldest discovered records of the human race, however, prove man to have been right-handed. Prehistoric weapons are those of right-handed individuals. Nearly all tools, etc., now in use are made for the right hand.

Right-handedness in man appears to be more persistent than the corresponding quality in lower animals. Naturalists, who observe that adult monkeys catch nuts more with the right hand, that the African elephant digs more with the right tusk, or that the Carolina parrot has a preferential claw for grasping, tell us that these habits are subject to exceptions more numerous than those of left-handedness in human beings.

Right of Way, the right to pass over a certain route or track in going from one place to another. Such a right is a public right of way if enjoyed by everybody; private if enjoyed by a certain person or description of persons (as the residents of a particular farm). Wherever there is a public right of way there is technically a highway, though the phrase is not used in connection with regularly-kept-up public roads, but generally with mere paths, tracts, or by-roads. The origin of a public right of way is generally said to be by dedication of it to the public by the owner of the soil.

Right Whale, the most important of the baleen whales. See **WHALE**.

Rights of Man, Declaration of the, a famous statement of the constitution and principles of civil society and government adopted by the French National Assembly in August, 1789. It suggested the title for Paine's defense of the French Revolution against Burke (1791-2); which was followed by Mary Wollstonecraft Godwin's 'Vindication of the Rights of Women.'

Rights, Declaration and Bill of. See **BILL**.

Rigi, rē'gī, or Righi, Switzerland, in the canton of Schwyz, an isolated mountain rising precipitously between Lakes Zug and Lucerne to a height of 5,905 feet. It may be approached by two railways of special type, and affords fine views, much visited by travelers. Ample accommodation is provided visitors in the way of hotels.

Rig'or Mor'tis, the rigidity of the body which comes on after death. It varies in the time of its appearance and also of its duration, sometimes setting in within a few minutes after the cessation of life, at other times not for many hours, and lasting in some cases but a very brief period, in others for several days. It is believed to be due to the coagulation of fluid substance in the muscular system which occurs after the withdrawal of nutrition from the tissues. Decomposition begins when relaxation of the body follows the passing off of the rigor.

Riis, rēs, Jacob Augustus, American journalist, author, and social reformer: b. Ribe, Denmark, 3 May 1849. He came to the United States in 1869, and worked at different trades, until he became a reporter on the *New York Sun*. In this work he gained a thorough knowledge of the conditions in the slums of the city, and by his lectures and writings aroused interest in the reforms in the tenement house district, and became a leader in the reform movement. When Theodore Roosevelt was police commissioner, Riis' thorough knowledge of the city was of the greatest aid to him, and the commissioner was usually accompanied on his all-night tours of investigation by Riis. Under the leadership of the latter police station lodging houses were abolished, small parks in crowded districts opened, playgrounds equipped, and many tenement house evils done away with. He, however, has held but one official position in connection with this reform work, that of secretary of the New York Small Parks Commission in 1897. His first book was *'How the Other Half Lives,'* published in 1890; other writings are *'The Children of the Poor'* (1892); *'Nisby's Christmas'* (1893); *'Out of Mulberry Street'* (1898); *'A Ten Years' War'* (1900); *'The Making of an American,'* an autobiography (1901); *'Battle with the Slums'* (1902); *'Peril and Preservation of the Home'* (1903); *'Theodore Roosevelt, the Citizen'* (1904).

Riley, rī'lī, Charles Valentine, American entomologist: b. London, England, 18 Sept. 1843; d. Washington, D. C., 14 Sept. 1895. He was educated at Dieppe and at Bonn, and in 1860 came to the United States where he spent three years in studying practical agriculture. He then engaged in newspaper work and in 1864 went to the front in the Union army. In 1868 he was appointed State entomologist of Missouri and in that year assisted in founding the *'American Entomologist.'* He was president of the Academy of Science at Saint Louis in 1876-7, chief of the United States entomological expedition under the Interior department in 1877, and in 1878 became United States entomologist in the department of agriculture, an office which he occupied until 1894 with the exception of 1879-80 when conducting the cot-

ton-worm investigation. In 1881 he was appointed curator of the National Museum and also became general secretary of the American Association for the Advancement of Science. He invented the "cyclone" or eddy chamber in nozzles for spraying purposes and made numerous discoveries of methods to control insect pests. His publications include: *'Annual Reports on the Insects of Missouri'* (9 vols. 1868-77); *'Annual Reports as Entomologist of the Department of Agriculture'*; *'Potato Pests'* (1876); *'Locust Plague in the United States'* (1877); *'The San Jose Scale'* (1895); etc.

Riley, James Whitcomb, American poet: b. Greenfield, Ind., 1853. After a public-school education, he became a sign-painter, and, when he deemed himself suitably proficient in art, turned strolling player, and composed songs and remodeled plays for the company of which he was a member. Still later, he was an editorial writer on the staff of the *Indianapolis Journal*. He began to contribute poems to Indiana papers in 1873. His verses in the Indiana dialect won for him instant success and the sobriquet of "The Hoosier Poet," by which he has been generally known. This work is quite unique in American literature. Riley is not, however, limited to this, but has written with melody and imagination in literary English. His public readings from his books became very popular, particularly in the Western States. The poem *'Leonainie,'* written by him in imitation of Poe, proved one of the most successful of literary hoaxes. He found a wide public, and at the beginning of the 20th century was among the most familiarly known litterateurs of the United States. His earlier verse and his first book, *'The Old Swimmin' Hole'* (1883), appeared over the signature of "Benjamin F. Johnson of Boone." Subsequent volumes are: *'Character Sketches and Poems'* (1887); *'Afterwhiles'* (1888); *'Pipes o' Pan at Zekesbury'* (1889); *'Old-Fashioned Roses'* (1891); *'Neighborly Poems'* (1891); *'Armazindy'* (1894); *'Rubaiyat of Doc Sifers'* (1897); *'Home-Folks'* (1900); and *'Out to Old Aunt Mary's'* (1903).

Riley, John, English painter: b. Bishops-gate, London, 1646; d. there 1691. He did not rise into notice until the death of Sir Peter Lely and remained unsurpassed until the appearance of Sir Joshua Reynolds. He was an imitator of Van Dyck, and in both drawing and coloring must be reckoned one of the best portrait painters of his time. He painted the portrait of Charles II., who rather disconcerted the artist by exclaiming: "Is this like me? Then, odd's fish, I am an ugly fellow." He also painted James II. and his queen, William and Mary, Bishop Burnet, Dr. Busby of Westminster, and Lord Keeper North.

Rimini, rē'mē-nē (ancient ARIMINUM), Italy, on the Adriatic, in the province of Forlì, celebrated for its mineral springs, the sea-bathing of the adjacent Porta Marina, and for the massive and elegant architecture of its chief buildings. Its fisheries are extensive. It was the seat of the celebrated Malatesta family. Pop. 50,000.

Rim'mon. See **RAMMON**.

Rimouski, rē-moos-kē', Canada, town in the county of Rimouski in the Province of

RIMU — RINDERPEST

Quebec; on the right bank of the Saint Lawrence River, and on the Intercolonial railroad; 185 miles northeast of the city of Quebec. The principal occupations are lumbering and fishing; trout and salmon are abundant. It is a favorite summer resort on account of its cool climate and the opportunities for hunting and fishing. Communications by water are cut off about half the year, when the river is frozen. Pop. about 1,500.

Rimu, or Red Pine, a New Zealand tree (*Dacrydium cupressinum*) of the yew family. It grows to a height of 40 to 80 feet, and from 2 to 6 feet in diameter. The branches are pendulous and feathery, and the leaves slender and needle-like. Its brown wood is valued for general building purposes. The young branches make good spruce beer.

Rinderpest, a general term covering various malignant diseases of neat cattle. Rinderpest proper is an acute infectious disease of cattle and sometimes of other ruminants, characterized by high fever, rapid pulse and cessation of milk-production during the first few days of the attack, followed by congestion and subsequently ulceration of the visible mucous membranes. The mortality is often as high as 90 per cent. This disease is on record since the 4th century. It was first known in eastern Russia and central Asia, whence it has periodically emerged, causing havoc in the herds of cattle and heavy losses to the various European nations. From Europe it spread to Egypt. It appeared in Somaliland in 1889 and spread southward, reaching the Zambesi in 1896. It caused great loss to South African farmers and led to troubles with the natives whose cattle were affected. Inoculation with a prepared virus has given encouraging results as a means of securing immunity. The stamping out process is the only way to combat the disease.

Pleuro-Pneumonia.—This "lung-fever" is a contagious malignant disease of cattle attended by inflammation of and exudation on the pleura and in the lungs. A disease, somewhat similar, has recently attacked goats. This disease has been recognized since the close of the 18th century, and at present occurs in Europe, Asia, Africa and Australia, but is under control in Great Britain. It was introduced into the United States in 1843, and outbreaks were reported at intervals. By 1883 the disease was distributed throughout the Eastern States and as far west as Chicago, and constituted a serious menace to the live-stock interests of the country. No temporary measures could be used in dealing with this scourge. The only ones practicable were quarantine, restriction of movement of cattle, slaughter of affected animals and disinfection. The wisdom of such measures is vouched for by the results. Less than five years of time and the expenditure of \$1,500,000, under the auspices of the Bureau of Animal Industry of the Department of Agriculture at Washington, sufficed to place this disease under control, and no case has been reported in the United States since 1892.

Anthrax.—This is a specific infectious disease of mammals including man, also known as splenic fever, charbon, wool-sorters' disease, etc., due to the presence in the blood of the micro-organism *Bacillus anthracis*. The dis-

eased animal may suddenly fall to the ground as in apoplexy and die, or it may live 10 to 24 hours or more in a sub-acute case. The symptoms are a high temperature, muscular trembling and labored breathing with prostration. The presence of the germ in the blood is proof of the disease. All carcasses should be burned, as if buried the germs may remain in the soil or be carried in the soil water. Cattle may be immunized by inoculating with attenuated virus, with toxins or antitoxin serums. Anthrax vaccine is on sale.

Blackleg, quarter-ill, etc., called also symptomatic anthrax, usually attacks young cattle. It is due to a bacillus. Immunity to this disease is conferred by vaccination with black-leg vaccine.

Texas, Southern, or Spanish Fever.—Texas fever is a contagious fever of cattle caused by a parasitic protozoan (*Pyrosoma bigeminum*), and is carried from southern cattle to northern cattle by the southern cattle-tick (*Boophilus borealis*). Adult ticks fall from the cattle, lay eggs, and thus infest the soil with young ticks that carry the germs. Northern cattle passing over the ground, get the ticks and subsequently the fever. When the ticks fasten themselves to the skin of cattle, they inoculate them with the parasites, which, in an unimmune animal, rapidly multiply, enter and destroy the red corpuscles of the blood, causing high fever and a temperature of 106° F. or more, general weakness and finally death. In the later stages the urine is highly colored, showing the great loss of red blood cells, giving rise to the name "red-water" for the disease. These symptoms and the presence of the ticks enable the disease to be recognized. Post-mortem examination reveals an enlarged spleen, containing a dark tarry substance instead of normal pulp. The ticks can be destroyed by dipping the cattle in a light lubricating oil containing dissolved sulphur. In the South cattle may be kept free from the fever by keeping them free from ticks in an uninfected enclosure. Young calves may be rendered immune by keeping ticks on them, and a considerable degree of immunity can be conferred on animals by inoculating them with the blood of southern cattle, thus producing the fever. This disease is thoroughly disseminated throughout the southern parts of the United States, and in 1899 regulations were promulgated establishing a Federal quarantine line from Virginia to California, and controlling the movement of southern cattle into the Northern States.

Foot and Mouth Disease or Aphthous Fever.—This is a contagious eruptive fever, attacking cloven-footed animals and communicable to many others, including man. Eruptions occur as blisters in the mouth, on the udder, teats and feet, with an elevation of temperature of from 2 to 6 degrees. Although in mild attacks only 2 to 3 per cent of the animals attacked succumb, it depreciates the value of the survivors from 20 to 50 per cent. When present in a malignant form, 5 to 50 per cent of the adults die, and 50 to 80 per cent of the calves. It is more to be feared than pleuro-pneumonia. The milk from diseased cows may transmit the disease to those partaking of it, and the disease produced in this manner is, especially when it attacks children, serious and sometimes fatal. The disease was first seen and recognized in

England in 1839 where it continued with more or less prevalence until 1886, when it abated only to reappear in 1892, 1894 and again in 1902, although no cattle were imported into the United Kingdom during this period. In 1870 it was introduced into the United States from Canada. In 1886 it was very prevalent in Europe and has continued its ravages to the present time. The introduction of the disease into New England in 1902 drew attention to the dangers of the malady. Isolation and quarantining of diseased animals is futile, and slaughter of diseased animals and prohibition of movement of stock in the infected areas are looked upon as the most efficacious method of eradicating the disease.

Tuberculosis.—One of the most insidious diseases affecting cattle and other animals. Like human tuberculosis, it is due to a germ, the tubercle bacillus which may affect any part of the body where it can secure a lodgment. Recent investigations show that the same bacillus may cause human and bovine tuberculosis, hence there is need to guard against human infection with bovine tuberculosis, and particularly to guard children from tuberculous milk. Plenty of good food, fresh air and sunlight, rigid cleanliness, the use of disinfectants, and the determination and isolation of affected animals are now viewed as the best means of checking the disease. The tuberculin test is a ready means of determining whether or not cattle are tuberculous. Tuberculin is made by growing the bacterium for two or three weeks in bouillon to which glycerine is added. The germs are then killed by heating and their remains removed by filtration. Carbolic acid is added to prevent decomposition and the fluid is packed in sealed sterilized bottles. Inoculation with this fluid causes a rise in temperature in the case of diseased animals.

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S. FRASER.

Rinehart, rin'härt, **William Henry**, American sculptor: b. Carroll County, Md., 13 Sept. 1825; d. Rome 28 Oct. 1874. He apprenticed himself at 21 to a marble-worker of Baltimore, and 10 years later went to Italy where he remained two years. On his return to Baltimore he executed several busts, and a fountain for the U. S. general post-office. He did not stay long in the United States, though his success as a sculptor met with much appreciation here, but established himself in Rome in 1858. Among his best known works are the reliefs 'Night' and 'Morning'; his highly poetic and well-wrought 'Clytie' and 'Love Reconciles with Death'; 'Latona and her Children'; 'Antigone'; 'Atlanta'; and 'Endymion.' He fin-

ished the bronze doors for the national Capitol, a work bequeathed to him by Crawford.

Rines, **George Edwin**, American editor: b. Maitland, Hants County, N. S., 28 Dec. 1860. Coming to the United States when 11 years old his early education was obtained in the public schools of Brooklyn, N. Y. For several years after graduating from the high school there he engaged in mercantile life, but in 1887 resumed his studies at Colgate University, Hamilton, N. Y. In 1890 he entered the full Hebrew and Greek course in theology, and graduated from the Hamilton Theological Seminary in 1893. He was for two years pastor at Binghamton, N. Y., afterwards accepting a call to the pastorate of the First Baptist Church of Ridgewood, N. J., where he remained for three years. He resigned from the ministry to devote himself to literary work, and has been a frequent contributor to religious and other periodicals. In 1903 he was appointed managing editor of the 'Encyclopedia Americana,' to which he has contributed many articles.

Ring, an ornament for the fingers which has been worn from the most ancient period of civilization. Among the ancient nations who are known to have attached special importance to the wearing of rings are the Assyrians, Egyptians, Hebrews, Greeks, and Romans. From the earliest period rings are associated with signets, and appear to have been worn as ornaments, especially by females, on various parts of the body besides the hand. The nose, ears, arms, and even the legs and toes have, among various peoples, been decorated with them. Rings have also from a very early period been reckoned as symbols of authority, and that in a double aspect. As a mere ornament rings would serve to represent dignity and honor, and as signets they were early used officially to delegate authority. Rings and bracelets are mentioned among the presents made by Abraham's servant to Rebecca. Among the Egyptians rings were worn in great profusion. They were made of gold, with an engraved stone or scarabæus, and were often very massive. The Egyptian rings were often of great size, so as to cover the space from one joint to another of the finger. In Sparta only iron rings were used. The Romans are variously said to have adopted the use of rings from the Sabines, the Etruscans, and the Greeks. For long they were made chiefly of iron, though sometimes of stone, and every free Roman had the right to use a seal-ring. The association of rings with marriage may have come down to us from the Romans, the bridal-ring being regarded as a pledge for the fulfilment of a contract. At first ring-wearing was confined to men among the Romans and was practised only to a limited extent, but growing luxury led to the excessive use of rings by both sexes. The right of wearing gold rings was at first accorded only to ambassadors, chief magistrates, senators, and finally to persons of the equestrian order, while silver began to supersede iron among ordinary citizens. Till the close of the republic the use of gold rings was a privilege of the equestrian order. A ring appears from an early period to have been one of the insignia of the office of a bishop and was often worn. The restoration of a deposed bishop was effected at the Council of Toledo (633) by returning to him the episcopal ring. Rings have always been in great demand among savage tribes when they have either had ingenuity enough to invent them, or have

RING AND THE BOOK — RINGGOLD GAP

come in contact with civilized nations who use them. Superstitious as well as sentimental feelings have often been associated with rings, and especially with the precious stones worn in them, to which particular characters were assigned. Rings were also used as charms against demons, evil eye, and other ills and inconveniences. Motto rings date from the time of the Romans; they appear also to have been in use among the Jews. They were long popular in Great Britain under the name of posies. See JEWELRY.

Ring and the Book, The, a poem of 21,000 lines by Robert Browning. This dramatic monologue, the longest and best sustained of Browning's poems, was published in four volumes in 1868-9, and is his greatest constructive achievement. It contains ten versions of the same occurrence, besides the poet's prelude, and presents from these diverse points of view the history of a tragedy which took place in Rome 170 years before.

Ring-bone, a bony excrescence on the pastern of a horse. It is a morbid growth, callus or exostosis, commonly due to inflammation, and in some cases extending to toe-joints with disabling effect. It is one of the more frequent ailments of horses and, although ordinarily affecting animals of inferior condition or injured by overwork, it sometimes appears in very young colts. While not always visibly impairing the serviceableness of a horse, ring-bone usually depreciates the market value of animals affected with it, and as cure is practically impossible it is a defect which calls for particular preventive methods in the care and breeding of horses, and for cautious scrutiny in the purchase of them.

Ring-dove, or Cushat. See DOVE; PIGEON.

Ring-money, in numismatics, an ancient metallic currency in the form of rings. This seems to have originated with the Egyptians, with whom rings were freely used as ornaments, and the same rings appear to have answered both purposes. The use of ring-money in Africa subsists to this day. A form of ring-money was also anciently used in Ceylon.

Ring-ouzel, oo'zel, a European thrush (*Turdus torquatus*), rather larger than a blackbird and of shy habits, preferring mountain slopes, heaths, and wild land to cultivated districts, but it often makes raids on fruit gardens and in vine countries feeds largely on grapes. In some parts of Scotland it is known as the moor blackbird. The song consists of a few loud, clear, and plaintive notes, and is somewhat monotonous. It is dark-brown with grayish wings and has a broad crescentic white gorget, whence the name. See OUZEL.

Ring Plover, or Ringneck, a common plover or dotterel (q.v.) of the whole northern hemisphere (*Ægialitis hiaticula*), distinguished by its black collar and its brilliant, gold-colored eyes. This bird was formerly celebrated in European folk-medicine. To be cured of the jaundice it was held to be only necessary to look fixedly at the bird's eyes with a firm faith in the success of the experiment. See PLOVER.

Ring Snake, the name of various serpents with a band encircling the body, especially

at the neck. In the United States the name belongs especially to a small harmless serpent of the warmer States (*Diadophis punctatus*), which is found "coiled up under stones, logs or the bark of fallen trees, chiefly in forests." It is bluish black above, yellowish orange beneath and has a whitish collar. In Great Britain the common grass-snake (q.v.) is often so called; in South America, the many-banded coral-snakes and in South Africa a large black and yellowish venomous hooded snake (*Sepedon hamachates*) known to the Dutch as "ringhals," and differing from the cobras only in anatomical peculiarities. Consult Gadow, 'Amphibia and Reptiles' (1901).

Ring-tailed Lemur. See LEMUR.

Ringgold Gap, Battle of. After the expulsion of the Confederates from Missionary Ridge 25 Nov. 1863 they retreated on Dalton (see CHATTANOOGA, BATTLE OF). To intercept the retreat, Gen. Thomas, on the morning of the 26th, ordered Gen. Hooker to push on Graysville, from near Rossville, and directed Gen. Palmer, commanding Fourteenth corps, to report to Hooker and join in the movement. On reaching Pea Vine Creek Palmer was ordered to move directly on Graysville, while Hooker, with his three divisions—Osterhaus', Geary's, and Cruft's—moved on Ringgold to strike the Confederate line of retreat six miles farther south. At 9 P.M. Palmer struck the Confederate rearguard, capturing three guns and some prisoners. Pushing on to Graysville, which was reached at 11 P.M., he captured more prisoners and another gun, and bivouacked for the night. Hooker advanced to within six miles of Ringgold, and late in the night bivouacked a short distance to the right of Palmer. At daybreak of the 27th Hooker renewed the pursuit, Osterhaus' division, in the advance, capturing many prisoners, and pursuing the Confederates into Ringgold. At 3 A.M. of the 27th Gen. Cleburne, whose division was acting as rear-guard to Hardie's corps, received an order from Gen. Bragg to hold Ringgold Gap, in Taylor's Ridge, near the town, until the trains and rear of the retreating troops could get well advanced. Cleburne disposed his four brigades of about 4,200 men on the ridge, on each side of the gap, and as a support two guns in it, and in less than half an hour Hooker came up and Wood's brigade of Osterhaus' division was ordered to attack. Cleburne's skirmishers were soon driven in; but Cleburne, assuming the offensive, attacked Woods' main line and was repulsed, Wood's men following to the gap. Meanwhile Williamson's brigade had made a lodgment on a spur of Taylor's Ridge, half a mile to the left of the gap, but found the Confederates so strongly posted that it could make no headway, and Creighton's brigade of Geary's division was ordered to ascend the ridge still farther to the left. Cleburne had anticipated the movement by still farther extending his right. Col. Creighton, making a gallant assault, was badly repulsed, and in falling back he carried part of Williamson's brigade with him. While Creighton was preparing for another assault he was killed, and operations on that part of the field were suspended. Meanwhile sharp work was going on in the gap and on the line on either side of it, without any material advantage to

RINGWORM — RIO GRANDE DO NORTE

Hooker. Between 12 and 1 o'clock Hooker's artillery came up and opened a furious fire upon Cleburne's position, but Cleburne had gone, leaving only a few skirmishers in the gap. These were closely followed by some of Geary's men to the bridges beyond the gap. Gen. Grant arrived on the field early in the afternoon, and ordered pursuit discontinued; later in the day Grose's brigade went forward, but encountering cavalry, supported by infantry, it returned to Ringgold. The Union loss at Ringgold Gap was 65 killed and 377 wounded. The Confederate loss, as reported by Cleburne, was 20 killed, 190 wounded, and 11 missing. Consult: 'Official Records,' Vol. XXXI.; and Van Horne, 'History of the Army of the Cumberland,' Vol. I.

E. A. CARMAN.

Ringworm, a disease occurring in three varieties, in one of which it attacks the scalp, in another the beard, and in the third some other part of the body. In all cases it is due to the presence of a vegetable parasite, consisting of minute round bodies, and of thread-like structures formed of rows of rod-shaped bodies of a beaded appearance. This is the growing fungus (*Trichophyton tonsurans*) and its spores, and wherever ringworm occurs this is present between the layers of cells of the scarf-skin, in hairs and hair-sheaths. Ringworm of the body (*Tinea circinata*) is the name given to the disease when it occurs on non-hairy parts of the body. It is most common on the face, neck, and trunk, but it also occurs on the hands, arms, and wrists. It consists of small circular patches, rose-colored and slightly raised, covered with small branny scales. Usually round the margin is a ring of very small blisters. The spot is the seat of a tingling and itching sensation. It spreads round the margins, and as it spreads the centre heals up, so that a large red ring with a pale centre is formed. Ringworm of the scalp (*Tinea tonsurans*), identical with favus (*Tinea favosa*), begins with small red patches like those described above and spreads at the margins. It involves the hairs, which become penetrated by the fungus, and are dry, dull, and twisted. They are easily pulled out and become very brittle. The affected patch becomes covered with a grayish-white powder. Inflammation may be produced and crusts formed. This variety of ringworm is commonest in children. Ringworm of the beard (*Tinea sycosis*) is similar to the scalp variety. A lotion of bichloride of mercury is often sufficient to kill the fungus, but if it prove ineffectual glacial acetic acid may be painted all round the spreading margins of the ring. In ringworm of the head and beard the hair of the diseased patches and for a little distance beyond should be cut short, and crusts should be removed by poulticing, washing with water and soft soap, etc. The general health should be maintained by the use of tonics and otherwise. Ringworm is very contagious.

Rio Branco, *rě'ō brāng'kō*, a large river of Brazil, entirely in the state of Amazonas. It rises on the eastern slopes of the Serra Parima, near the sources of the Orinoco, flows eastward parallel to the Serra de Pacaraimo, turns southward before reaching British Guiana, and joins the Rio Negro about lat. 1° 25' S., lon. 61° 10' W. It has a length of about 830 miles, and receives numerous affluents.

Rio Cuarto, *koo-ār'tō*, Argentina, a town of Córdoba province, near the source of the Cuarto River, on the railroad midway between Belleville and Villa Mercedes, 119 miles south of Córdoba. It is the distributing centre of a large agricultural region. Pop. 14,000.

Rio Grande, *rě'ō grānd* (Sp. *grān'dā*), or **Rio Grande del Norte**, a river which has its rise in the southwestern part of Colorado, flows south and southeast until it enters New Mexico, when its general course about half way across the Territory is south by west, then south by east to El Paso (q.v.), whence it forms the irregular boundary between Texas and Mexico. It enters the Gulf of Mexico after a course of nearly 1,900 miles. It is navigable for small boats only to Kingsbury Rapids, near Presidio, about 460 miles from its mouth. In the upper course the banks are generally high, and the irregular rocky beds form rapids and waterfalls. In the lower part of its course, the stream is shallow, and it is subject to periodical inundations. The largest tributary is the Pecos River, which enters the Rio Grande from Texas. A number of U. S. forts are on this river. The most important places are Brownsville, Eagle Pass, Laredo, and El Paso in Texas; and Matamoros and Nuevo Laredo in Mexico. A few villages and towns of importance are on the banks of the river in New Mexico.

Rio Grande de Cagayan, *rě'ō grān'dā dā kă-gă-yān'*, the largest river of the island of Luzon, Philippines. It rises on the northeastern slope of Carabellos Sur, and flows north in a winding course to the China Sea. It drains a large territory, and has numerous tributaries, the chief of which are the Magat and the Chico de Cagayan; its valley is very fertile, the land being used mainly for the cultivation of tobacco. The river is navigable for vessels drawing 12 feet as far as Lal-ló, 13 miles from its mouth; and for light draft vessels for 200 miles in the wet season. Freshets occur at times with a rise of several feet in a few hours.

Rio Grande College, located at Rio Grande, Ohio; founded in 1876 under the auspices of the Free Baptists. It offers a classical and a scientific course, and confers the degrees of bachelor of arts and bachelor of science. There is also a preparatory department. The college is co-educational, and women constitute fully one half of the student body. The grounds and buildings in 1910 were valued at \$40,000; the library contained 3,500 volumes; the productive funds amounted to \$76,000; and the annual income to \$6,000. The students numbered 175 and the faculty 10.

Rio Grande de Mindanao, *rě'ō grān'dā dā mēn-dā-nōw'*. See MINDANAO, GRANDE DE.

Rio Grande do Norte, *rě'ō grān'dā doo nōr'tā*, an important maritime state in the northeast of Brazil; area, 22,196 square miles. The surface is mountainous in the south and southwest, where it is covered by several mountain ranges. The principal rivers have all either a north or an east direction. The proximity to the equator makes the climate intensely hot; it is said, however, not to be unhealthy, the air being remarkably pure. The soil is generally good, but not remarkable for its fertility. For a long time the sugarcane was the principal cultivated crop, but considerable tracts formerly

RIO GRANDE DE LA PAMPANGA — RIO DE JANEIRO

devoted to it are now occupied by cotton, which may be regarded as the staple of the province. The other leading crops are manioc, millet, and haricots. Many of the plains are grazed by large herds of horses and cattle. The minerals include gold, silver, iron, salt, amethysts and rock-crystals, limestone, sandstone, and granite. The forests are not very extensive. Pop. 268,273.

Rio Grande de la Pampanga, *rē'ō grān'dā dā lā pām-pān'gā*. See PAMPANGA, RIO GRANDE DE LA.

Rio Grande do Sul, *rē'ō grān'dā doo sool*, a southern maritime state of Brazil; area, 91,336 square miles. Along the coast for more than half the extent of the coast-line of this state stretches the great Lago dos Patos, which communicates with Lake Mirim, and which receives the rivers of the southeastern part of the territory. Those to the southwest belong to the basins of the Paraná and Uruguay, and flow west. The mountain chain called Serra Geral divides the state into two unequal parts. The sea-coast is flat and sandy, and is lined by a series of reefs, which make the navigation dangerous. The interior is partly occupied by arid serras, but is mostly fertile. The climate is temperate, and the productions are more like those of Europe than of the rest of Brazil. Maize, rice, and flax, particularly the first, are largely cultivated. The finer European fruits, especially figs and peaches, find a genial soil. The minerals include gold, iron, sulphur, and porcelain clay of the finest quality. The chief occupation of the inhabitants is the rearing of cattle and the preparation of dried beef. Horses and mules are also reared. A number of German colonists and many Italians have settled in the state. There are several railways. Porto Alegre is the capital. Pop. 897,455.

Rio de Janeiro, *rē'ō dā zhā-nā'rō*, Brazil, one of the maritime states on the southeast coast of the republic; area, according to official returns, 26,634 square miles. The central part of this territory is mountainous, being traversed generally from east to west by a series of ranges, of which the loftiest and most conspicuous is the Serra dos Orgãos or Organ Mountains (q.v.). They are almost entirely composed of granite. The mountains slope down on the north and south—in the former direction toward the basin of the Parahyba, to which all the surface of the province on that side belongs; and in the latter to the coast, which receives the drainage from a great number of comparatively small streams, each carrying its waters directly to the ocean. The shore toward the northeast is lined by numerous lakes and lagoons. The soil does not seem to possess much natural fertility. Great part of it consists of a retentive clay, ill adapted for agricultural operations; but the warmth and moisture of the climate are so favorable to vegetation that magnificent forests and valuable crops are found, and there are many tracts of the richest land which are turned to the best account. The crop which attracts the largest share of attention is coffee. The other leading crops are sugar, rice, millet, manioc, and cotton. The forests are rich in timber, both for ordinary and ornamental purposes; in dye-woods, in gums and balsams, and valuable medicines. The domestic

animals, originally imported from Europe, have increased considerably, and immense herds of cattle are reared. This province is not rich in precious metals. Iron, however, abounds, though it is not worked; and the decomposition of granite has formed extensive beds of the finest kaolin. The state assembly used to meet at Nictheroy, but Petropolis is the present capital. Under separate jurisdiction from the state is the federal district of Rio de Janeiro, embracing the city of the same name (q.v.) and its surroundings. The population, inclusive of the federal district, according to the last census was 1,399,535.

Rio de Janeiro, capital of the United States of Brazil; socially and commercially the most important city of South America, excepting Buenos Ayres. The name is supposed to perpetuate an error of the discoverers (1 Jan. 1502), who, seeing the great length of the bay, assumed that it was the mouth of a river (*rio*). It is, in fact, a capacious and excellent natural harbor, with an area 68 square miles greater than the combined areas of the lower and upper bays of New York. But the bottom has silted up so much in recent years that the water near the shores has become too shallow for large vessels. Accordingly, some of the old mooring places have been abandoned. Merchant vessels which are unable to reach the docks cast anchor on the north side of the city, and their cargoes are transported in lighters. The future prosperity of Rio depends upon the successful execution of the plan for harbor improvements, which in 1903 was entrusted by the government to a British firm. Modern facilities for handling freights are to be provided in connection with a wide quay of solid masonry, which will extend along the entire northern front to a deep artificial channel. The outer wall of this quay, for about two miles, will be accessible to the largest shipping, and railway trains will run to the same point. This important work will, it is thought, be completed in 1910. The city proper is very compactly built on flat land adjoining the bay, but its suburbs stretch out along the shores for more than 17 miles. Above the crowded central portion rises Sugar Loaf Peak (*Pão d'Assucar*), and on the same side of the harbor is the fortress called São João—opposite which, on the eastern promontory, is Santa Cruz fortress. A small island, lying in the entrance between São João and Santa Cruz, is also fortified; and other defensive works are located in the bay on an island, which takes its name from the French adventurer Villegaignon, who tried to establish a colony of Huguenots there (1555–60). The main body of the city, covering less than a square mile, is divided into regular squares by narrow streets, along which pass lines of electric or horse cars, furnishing the only available means of transportation. The length of these lines is about 175 miles, and in 1897 the companies carried 83,000,000 passengers. The number of buildings in Rio is approximately 50,000, and its total area is sometimes said to be equal to that of any other capital in the world, but in such reckonings forest-covered hills are included. The most attractive suburban districts are Botafogo and Laranjeiras, the former built around an arm of the bay, the latter in a valley at the foot of

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Mount Corcovado; in both the residences are surrounded by beautiful tropical gardens. The National Museum, formerly the Imperial Palace of Boa Vista, is in the district of São Christovão. Some of the finest buildings—the Senate, City Hall, Mint, Normal School, Quartel-general, etc.—surround the old park, Praça 15 de Novembro, now called Campo de Sant' Anna. The Department of Foreign Relations occupies the old Palace of Itamaraty; the present government palace was formerly the luxurious residence of Conde de São Clemente the Chamber of Deputies, Department of Telegraphs, and Historical Institute are installed in the old Paço Palace. On the other hand, a fine modern building is devoted to the Department of Industry. An especially interesting feature is the Botanical Garden, in which rare exotics from all countries of the globe are cultivated, side by side with specimens of the flora of the various parts of South America. The Cathedral and Church of Santa Cruz stand near the water front, in a large square from which starts the main business street, Primeiro de Março. The rendezvous for men of prominence, an "open-air club," and the active centre of municipal life, is the Rua Ouvidor, a street of restaurants, book-shops, and newspaper offices. The very large wholesale and foreign trade of the city is in the hands of Portuguese, Brazilian, English, German, and French merchants. In the list of exports, coffee is the principal item; imports consist chiefly of food products and manufactured articles. There are at Rio cotton mills, furniture manufactories, foundries, dry docks, a naval arsenal, etc. A system of railways, of which the capital is the centre, covers the state and the southern part of Minas Geraes. The "Brazil Central" system is the most important in the republic, connecting Rio with São Paulo, and having a large number of branch lines, beside controlling the terminal facilities of the port and the suburban traffic. Originally known as the Dom Pedro Segundo Railway, this line was begun by a company in 1857, under a governmental guaranty. In 1860 the imperial government took control of it. Since the establishment of the republic the line has been extended to a length of 759 miles, and the cost of this system to the government has been approximately \$97,300,000 gold, or \$126,000 per mile. The road is moderately well built and equipped. Beside the numerous suburban trains, there are seven daily trains running to Barra do Pirahy, the junction point of the São Paulo and Minas divisions. Vessels entering the port in 1900 numbered 1,703, including 860 coasting vessels; those clearing numbered 1,707 (coastwise 917). The number of inhabitants is more than 800,000. On account of "poor sewerage and lack of hygienic measures," the city is one of the most unhealthful in Brazil. Yellow fever is endemic; smallpox and tuberculosis make great ravages from time to time. In the low-lying central section the heat of summer is exceedingly unpleasant, though elevated places in the vicinity—Corcovado Mountain, Petropolis (q.v.), Nova Friburgo, and other resorts—have an admirable climate. The water supply is regarded as very good. For public instruction see EDUCATION IN LATIN AMERICA. Useful institutions of public charity are the hospitals of the Sociedade de Beneficencia and the

very large Santa Casa de Misericordia, the former supported by the philanthropic Portuguese colony. Some events in the early history of this region are mentioned in the article BRAZIL. In Rio and São Paulo in 1870 was organized the Republican party, which brought to pass the overthrow of the monarchy without bloodshed (15 Nov. 1889); and the bay of Rio de Janeiro was the principal scene of the revolt of the navy, which, from 6 Sept. 1893 to March 1894, menaced the new Brazilian institutions. Compare: 'United States of Brazil: A Geographical Sketch,' Washington, Government Printing Office (1901). MARRION WILCOX, *Authority on Latin America.*

Rio Negro, rê'ô nă'grô ("black river"), the name of numerous streams, of which two are important: (1) A river of South America, and principal tributary of the Amazon. It rises in Colombia, and joins the Amazon after a course of about 1,000 miles at Manaos, Brazil. Through its affluent, the Cassiquiari, there is direct communication between the Amazon and Orinoco. (2) A river of South America forming the boundary between the Argentine Republic and Patagonia. It rises in the Andes in Chile, and is about 700 miles long. Its current is very rapid, and its bed obstructed with shoals and sand banks.

Rio de la Plata, rê'ô dă lâ plă'tă. See PLATA, RIO DE LA.

Riobamba, rê-ô-băm'bă, Ecuador, a town on the Pastasa River, a branch of the Amazon, about 100 miles from Quito. A former town of the same name, at the foot of Chimborazo Mountain, about 9 miles from the present town, was destroyed by an earthquake in 1797. Riobamba has a population of about 17,000, most of them Indians.

Rioja, Francisco de, frăn-thēs'kô dă rê-ô'hă, Spanish lyric poet: b. Seville about 1600; d. Madrid 8 Aug. 1659. He studied first law and then theology. The minister Olivarez obtained for him a prebend in the cathedral of Seville, and then became royal historiographer, inquisitor at Seville, and lastly, inquisitor of the supreme tribunal of the holy office. The downfall of his patron involved his own: he was imprisoned, and only obtained his liberty after he had undergone a formal trial and completely established his innocence. Philip IV., whose favor he had regained, made him director of the royal library and councillor in the supreme court of the Inquisition. As a poet, he formed himself on the classic and Italian models, particularly Horace and Seneca; kept himself, in style and language, free from the tasteless eccentricities of his contemporaries, and thus preserved the true spirit of the lyric. His 'Silvas' exhibit rich pictures of rural life, remarkable for their truth to nature. His works were published with a biography by D. Cayetano de la Barrera, 'Poesias' (1868); and 'Adiciones a las poesias de D. Francisco de Rioja' (1872). Consult Longfellow, 'Poets and Poetry of Europe' (1843).

Rioja, La, Argentina; (1) the capital of a province 118 miles by rail southwest of Catamarca, at the foot of the Sierra Velasco, in the midst of vineyards and orange groves. Pop. about 7,000. (2) A western province north

of San Juan and south of Catamarca, with an area of 69,502 square miles, divided into 18 departments. While in the east and south there are salt and sand deserts, it is well watered on the west, and agriculture and cattle rearing are important industries. Excellent wheat, fruits, and wine are produced. The climate is dry and healthful. Near Chilecito and Famatina are valuable gold, silver, and copper mines. Pop. about 79,000.

Rion, *rē-ōn'*, or **Rioni**, *rē-ō'nē*, from **Phasis**, a river of Colchis (Transcaucasia, Asiatic Russia), anciently regarded as the boundary between Europe and Asia. It was afterward held as the boundary line between Colchis and Asia Minor. It rises in a spur of the Caucasus (Moschici), and after receiving the rivers anciently called the Rhion, the Glaucus, and the Hippus, it falls into the Euxine near the ancient town of Phasis. In the early part of its course it was called the Boas. Its modern name is Rion or Rioni. Other rivers were sometimes confounded by ancient writers under the same name with this. The Phasis of Xenophon was the Araxes.

Riordan, *rē'or-dan*, **Patrick William**, American Roman Catholic archbishop: b. New Brunswick 27 Aug. 1841. He was educated at Notre Dame, Ind., and was graduated from Louvain, Belgium in 1864. He then returned to Chicago, accepted the chair of theology at the Seminary of Saint Mary's of the Lake, and in 1868-71 was pastor of Saint Mary's church at Joliet, Ill. From 1871-83 he was in charge of Saint James' Church, Chicago, and in the latter year was consecrated titular archbishop of Cadesa and was made coadjutor. He succeeded to the see of San Francisco in 1884.

Riordan, **Roger**, American artist and author: b. Ireland 1848. He studied art at the Art Students' League in New York, has contributed as illustrator and writer on art subjects to various magazines, and served on the international jury of awards at the Paris Exposition, 1900. He has published 'Sunrise Stories, a Glance at the Literature of Japan'; 'French Etchers,' and collaborated on the Catalogue of the Marquand collection.

Riot, a disturbance of the public peace, attended with circumstances of tumult and commotion, as where an assembly destroys, or in any manner damages, seizes, or invades private or public property, or does any injury whatever by actual or threatened violence to the persons of individuals. By the common law a riot is an unlawful assembly of three or more persons which has actually begun to execute the common purpose for which it assembled by a breach of the peace, and to the terror of the public. A lawful assembly may become a riot if the persons assembled form and proceed to execute an unlawful purpose to the terror of the people, though they had not that purpose when they assembled. In England, every person convicted of riot is liable to be sentenced to hard labor. In Scotch law rioting is termed mobbing. A person may be guilty of mobbing who directs or excites a mob, though he is not actually present in it. Mere presence without participation may constitute mobbing. A majority of the States of the American Union have riot acts somewhat similar to those of England, and the

common law governs where no statutes have been enacted.

Riouw-Lingga, *rē'ow līn'ga*, or **Riou Lingga**, an archipelago southeast of the Malay Peninsula, belonging to Netherlands. It is formed of two groups of islands, the northern group is that of Riouw, and the southern, Lingga. There are about 30 islands in the Riouw group, the largest, Bintang, has an area of 400 square miles. Lingga, of the Lingga group, has an area of 320 square miles; Singkep, 204 square miles. The soil of the greater part of the archipelago is fertile, and the whole is well wooded. The principal export is gambir; other exports are pepper, sago, and rice. Tin has been mined and exported for many years. The original inhabitants have nearly all disappeared; the population now is made up of Chinese, Japanese, Javanese, and Kings. Pop. about 78,000.

Rip-rap, a common name applied to broken stones used for beds, walls and foundation in building and construction. See **MASONRY**.

Rip Van Winkle, *rip vān wīng'kl*, a character in one of Washington Irving's legends of the Hudson Valley. While hunting among the mountains he falls in with the reputed followers of Hendrik Hudson and by drinking the liquor they offer him is cast into a sleep of 20 years. When he awakes and returns to the village of Laughing Water, he finds all things changed, but is chiefly relieved to discover that his wife, the irritating obstacle to his easy-going life is no longer alive. The story has been dramatized by Joseph Jefferson (q.v.), and forms one of the important roles in his repertory.

Riparian Rights are those of one who owns the land bounding upon a water course; such owner is the proprietor of that portion of the bed of a river which adjoins his land; such rights upon navigable waters depend largely upon statute and customs of the different jurisdictions. A riparian owner has the right of access to navigable water, and for that purpose to erect a wharf or pier, provided it does not encroach upon the navigable waters sufficiently to interfere therewith. A riparian owner has also a right to the accretions of the soil and to fish in the adjacent waters; he has also the right to have the stream flow naturally without changing it in quantity or otherwise. Such owner is not entitled to the water, but merely to its use, and is without the right to divert, obstruct or corrupt the stream, except to build such lawful obstructions as may be necessary for bridges, wharves and dams. Riparian rights of property are established property, of which the owner cannot be deprived except by due process of law. (See **RIVERS**.)

Ripley, *rip'li*, **Eleazar Wheelock**, American soldier: b. Hanover, N. H., 15 April 1782; d. West Feliciana, La., 2 March 1839. He was graduated from Dartmouth College in 1800, engaged in law practice and in 1811 settled at Portland, Maine. In 1810-11 he was a member of the Massachusetts legislature, served as speaker in the latter year and in 1812 was elected State senator. At the outbreak of the War of 1812 he entered the army, became brigadier-general in 1814, and for services at Niagara, Chippewa, and Erie was voted a gold medal

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by Congress. He remained in the army until 1820 when he removed to Louisiana and resumed the practice of law. He afterward served in the State senate and was a member of Congress from 1835 until his death.

Ripley, George, American author: b. Greenfield, Mass., 3 Oct. 1802; d. New York 4 July 1880. He was graduated at Harvard in 1823, studied theology at Cambridge and in 1826 was ordained a Unitarian minister in Boston. He became interested in the principles of Fourier, Comte, and St. Simon, and made translations of the writings of modern German and French philosophers and endeavored to introduce their ideas in America. He collaborated with Dr. Hodge on a large work in 14 volumes, 'Specimens of Foreign Standard Literature' (1838-42). His 'Discourses on the Philosophy of Religion' (1839) gave rise to a long and bitter controversy with Professor Andrews Norton of Cambridge. He was a leader in the Transcendental Movement originating in 1836 in association with Emerson and others, wrote frequently for 'The Dial,' the organ of that movement. In 1841 he definitely retired from the ministry and became the prime mover in the communistic enterprise of Brook Farm (q.v.), and in 1844 invested all his small fortune in that settlement in West Roxbury. After the burning of the phalanstery in 1846 and the dispersion of the colony, he went to New York as literary editor of the *Tribune*; contributed also to the literary department of 'Harper's Monthly.' With Bayard Taylor he edited a 'Handbook of Literature and Fine Arts' (1852), and in 1858, with Charles A. Dana (q.v.), began the editing of 'Appleton's New American Cyclopedia.' Consult: Frothingham, 'George Ripley' (1882); Swift, 'Brook Farm' (1900).

Ripley, James Wolfe, American soldier: b. Windham, Conn., 10 Dec. 1794; d. Hartford, Conn., 16 March 1870. He was graduated from West Point in 1814, served in the second war with Great Britain, his first engagement being in the defense of Sackett's Harbor. In 1818 he was promoted lieutenant, fought in the Seminole war and was appointed commissioner to establish the boundary line of the Florida reservation in 1823-4. He was captain in command of Charleston Harbor at the time of the Nullification troubles in 1832-3 and in 1841-54 was superintendent of the Springfield Armory. He was brevetted lieutenant-colonel in 1848 for services in the Mexican War, receiving full rank in 1854. He was promoted brigadier-general in 1861, and after 1863 was inspector of fortifications on the coast of New England. He was brevetted major-general in 1865.

Ripley, William Zebina, American educator and economist: b. Medford, Mass., 1867. He was graduated from the Massachusetts Institute of Technology in 1890, made a specialty of economics and in 1893 became lecturer at Columbia. In 1895-1901 he was professor of economics at the Massachusetts Institute of Technology and since 1901 has occupied that chair at Harvard. He has published: 'Financial History of Virginia' (1893); 'The Races of Europe' (1899); etc.

Ripley, Ohio, village in Brown County, on the Ohio River, and on the Chesapeake & Ohio railroad; 45 miles southeast of Cincinnati. It

was founded about the time of the War of 1812, and was at first called Stanton; later its name was changed in honor of General Ripley, an officer in the war. For a time the county courts were held here, but the county-seat was finally moved to Georgetown. The first station on the "underground railway" for runaway slaves was located in Ripley. It is in a noted tobacco region, and has a number of tobacco packing houses and factories; its other industrial establishments include a piano factory and shoe factories, and it carries on a considerable river trade. Pop. 2,350.

Ripon, rip'ôn, England, a cathedral city in the county of York (West Riding), on the Ure, 22 miles by rail northwest of York. The cathedral of Saints Peter and Wilfrid, restored 1862-76, is one of the finest churches in England; length, east to west, 266 feet; width of transept, 132 feet; the three towers 120 feet high, were crowned by spires prior to 1660. The city has also other fine ecclesiastical, municipal, and benevolent institutions. The principal manufactures are machinery, saddle-trees, leather, and varnish. The abbey of Ripon was founded in the 7th century, and the Saxon crypt of the cathedral was probably built by Wilfrid in 674-678. The see of Ripon was established in 1836.

Ripon, Wis., city in Fond du Lac County; on Silver Creek, an inlet of Green Bay, and on the Chicago & N., the Chicago, M. & St. P. R.R.'s; about 85 miles northwest of Milwaukee, and 18 miles west by north of Fond du Lac.

Ripon was settled in 1844 by the "Wisconsin Phalanx" (q.v.) an organization of 19 members, founded at Southport, Wis. The "Phalanx" was based upon Fourier's principles, but only the best of Fourier's rules were followed; free-love ideas never gained a foothold here. The advantages for farming in the rich Ceresco Valley caused the "Phalanx" to locate in what is now Ripon and the surrounding lands. The name they gave to the valley, Ceres, the goddess of grain, and Co., company, making Ceresco, shows that agriculture was of first interest. The city was named Ripon by John Homer, whose ancestors had lived in Ripon, England. The "Phalanx" prospered and held together as an organization for six years. The reports of gold in California was one of the causes of unrest which led to the voluntary and peaceable disbanding of the organization in 1850. The enterprise had prospered so well that at the final division eight per cent above par was paid on the stock. The city was incorporated in 1849 and chartered in 1858. Ripon claims to be the birthplace of the Republican party, and one of the historic buildings is pointed out as the place where the first meetings were held and where the party received its name. The chief industrial wealth of the city is connected with the products of the rich farms of the valley. Grain, fruit and vegetables are abundant, and the dairy products are of considerable value. The chief manufacturing establishments are knitting works, in which there are 200 employees; glove factory, 50 employees; carriage works, 50; machine shops, 20; and pickling works, creameries, box and crate factories, and flour and feed mills. There are 10 churches, and a number of fine business blocks. The educa-

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tional institutions are Ripon College, organized in 1851, a high school, graded elementary schools, and a free public library. The two banks have a combined capital of \$175,000. The government is vested in a mayor and a council of eight members, who hold office two years, four of whom are elected each year. Ripon is a favorite summer resort on account of its climate, beautiful scenery, and the attractive drives to nearby points of interest. Pop. (1900) 3,818; (1910) 4,090. The population doing business in Ripon is about 7,000.

C. H. ELLSWORTH,
Editor 'The Ripon Commonwealth.'

Ripon College, located at Ripon, Wis., organized in 1853. Though the Congregationalists have contributed largely to its support and prosperity, it is not under denominational control. Its organization includes a collegiate department, a preparatory department, and departments of music and of art; normal courses are also given. In 1901 the group system of elective studies was adopted and a new professorship in history and economics established; the collegiate courses are arranged in three general groups, classical, literary and scientific, but only the one degree of A.B. is conferred. Women are admitted to all departments. The campus includes 10 acres; the grounds and buildings in 1910 were valued at \$196,300; the library contained 19,000 volumes, and the annual income was \$62,000. The students for the year 1910 numbered 258, and the faculty 26.

Ripple-mark, a furrowed or wavy surface often caused on sand by the motion of water or the action of wind, or by their combined agency. Such marks are seen on sandstone of all ages, where they are considered to have been produced by the ripple of the tide on what was once the sandy shore of an ancient sea. Beach ripple may generally be distinguished from ripples due to currents by the frequent changes which occur in its direction.

Rise of the Dutch Republic, *The*, a historical work by John Lothrop Motley, first published in 1856. It proved an immediate popular success; and was followed by a French translation (supervised with an introduction by Guizot) in 1859, and soon after by Dutch, German, and Russian translations.

Rishis, rī'shīs or r'shīs, sages of the Hindu mythology, sprung from the mind of Brahma, and attendants in alternate months on the sun. Seven of them are enumerated. The Rishis were also inspired sages, of whom the Vishnu Purana enumerates three kinds—royal rishis, or princes, who have adopted a life of devotion; divine rishis, who are both sages and demigods; and Brahman rishis, or sons of Brahma. Rishi afterward came to be applied to all personages distinguished for piety and wisdom.

Risley, rīz'li, **Richard Voorhees**, American novelist: b. New York 8 Nov. 1874; d. there 30 March 1904. He was educated in military and other schools and spent several years in foreign travel. He has published: 'The Sentimental Vikings' (1897); 'Men's Tragedies' (1899); 'The Sledge' (1900); 'The Anvil.'

Ristori, rēs-tō'rē, **Adelaide**, Italian actress: b. Cividale, Italy, 29 Jan. 1822; d. Rome, 9 Oct. 1906. She appeared on the stage as a child, and her early parts were in Soldoni's

comedies. After her marriage in 1846 to the Marchese Giuliano del Grillo she retired from the stage for a time, but after her return she devoted herself thenceforth to tragic roles. In 1855 she appeared in Paris in Silvio Pellico's tragedy of 'Francesca da Rimini' and achieved a great success. Her engagement there was followed by a tour of Europe and from that time she was frequently seen in the large cities of the Continent and Great Britain. She made her first appearance in America at the Lyric Theatre, New York, 20 Sept. 1866, and her tour of the United States lasted for eight months. In 1869 she played in South American cities and in 1874 made a journey round the world. She made her fourth and last visit to the United States in 1884 and during that tour which ended in May of the following year appeared as Lady Macbeth in company with Edwin Booth. After 1885 she did not appear on the stage. Her greatest parts were Mary Stuart, Myrrha, Medea, Phædra, Lady Macbeth and Queen Elizabeth.

Ritchie, rī'chī, **Anna Cora Ogden Mowatt**, American actress and author: b. Bordeaux 1819; d. Henley-on-Thames, near London, England, 28 July 1870. She was successful as a playwright and dramatic reader, and in 1845-54 appeared with much favor on the stage in both the United States and England, where she was seen with E. L. Davenport (q.v.). Some of her books were published under the pseudonyms of 'Isabel,' and 'Helen Berkley.' They include: 'The Fortune-Hunter' (1842); 'The Mute Singer,' 'Fashion,' a comedy (1847), which was very popular; 'Evelyn' (1845); 'The Autobiography of an Actress' (1854), the best-known and most popular of her productions; 'Mimic Life' (1855); 'Fairy Fingers' (1865); 'The Clergyman's Wife' (1867).

Ritchie, **Anne Isabella Thackeray**, English author: b. London 1837. She is the eldest daughter of William Makepeace Thackeray (q.v.) and was educated at Paris and Kensington and in 1877 was married to Richmond Ritchie. Her first literary work was published in the 'Cornhill Magazine' while her father edited that periodical. In 1863 she published 'The Story of Elizabeth' which met with success. Since that time she has published fiction, biography and literary reminiscences, among which may be named: 'The Village on the Cliff' (1865); 'To Esther, and Other Sketches' (1869); 'Old Kensington' (1873); 'Toilers and Spinners' (1873); 'Bluebeard's Keys' (1874); 'Miss Angel' (1875); 'Anne Evans' (1880); 'Madame de Sévigné' (1881); 'A Book of Sibyls' (1883); 'Mrs. Dymond' (1885); 'Records of Tennyson, Ruskin and Browning' (1892). The biographical edition of Thackeray's works was edited by her, and her prefaces and notes contain a partial substitute for an authoritative biography against which Thackeray left a prohibition. Her 'Chapters from Some Unwritten Memoirs' (1895) is a work of autobiographical character.

Rite, in religious use, any external sign or action employed as an expression of reverence or devotion, or as a means of exciting internal religious sentiments. The ancient religion of Judaism abounded in rites and ceremonies, and the sect or school of the Pharisees appears to have laid more stress on compliance with these

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observances than on the weighty injunctions of the law. Jesus Christ repeatedly expressed contempt for the scruples of the Pharisees, and many of those who aim to walk strictly in his footprints repudiate everything like ceremonialism in divine worship. But the vast numerical majority of Christians demand a more or less stately and impressive ceremonial. Rite is used also to express the sum of the ceremonial employed in the administration of the sacraments, as, the "rite" of baptism, the "rite" of confirmation, "the last rites"; again, the entire liturgical ceremonial of a particular branch of the church is spoken of as a "rite," for example, Latin rite, Greek rite, Syrian rite, etc.

Rites, Congregation of, a commission or standing committee of cardinals of the Roman Catholic Church, instituted in the 16th century by Sixtus V. Its function is to exercise supervision throughout the entire church over all ecclesiastical rites and ceremonies, in particular those belonging to the Mass, with a view to prevent the introduction of novelties without express approval, and to maintain unaltered the usages sanctioned by the tradition of the Fathers and the prescriptions of the rubrics. It is the Congregation of Rites that takes cognizance of all matters concerned with the beatification and canonization of deceased servants of God.

Ritschl, ritsh'l, Albrecht, German theologian: b. Berlin 25 March 1822; d. Göttingen 20 March 1889. He studied in the universities of Bonn, Halle, Heidelberg, and Tübingen, qualified at Bonn as a lecturer in 1846, became extraordinary professor of theology there in 1852, and ordinary professor in 1859. In 1864 he accepted a call to the corresponding chair at Göttingen. From 1874 he was a consistorial councillor. In his early thesis, 'Das Evangelium Marcions und das kanonische Evangelium des Lukas' (1846), he adopted the position of his master, F. C. Baur, but in the first edition (1850) of his 'Entstehung der altkatholischen Kirche' ('Origin of the Early Catholic Church') he showed signs of divergence, and the publication of the second edition of the latter work in 1857 marked his complete severance from the Tübingen school. His chief subsequent works are: 'De Ira Dei' (1859); 'Die christliche Lehre von der Rechtfertigung und der Versöhnung' ('The Christian Doctrine of Justification and the Atonement,' 3 vols. 1870-74; 3d ed. 1888-9), his chief work; 'Schleiermachers Reden über die Religion und ihre Nachwirkungen auf die evangelische Kirche Deutschlands' (1874); 'Die christliche Vollkommenheit' ('Christian Perfection,' 1874); 'Unterricht in der christlichen Religion' (1875; 5th ed. 1895), a succinct statement of his theological position; 'Geschichte des Pietismus' (1880-6); 'Theologie und Metaphysik' (1881); 'Drei akademische Reden' (1887); 'Fides Implicita' (1890); and 'Gesammelte Aufsätze' ('Collected Essays,' 1893 and 1896). Ritschl founded a school of theology still of much importance both in Germany and in other countries. Starting from a subjective theory of cognition, based upon the philosophy of Kant as developed in Lotze, he sought to eliminate the whole metaphysical element from religion. He was thus led to reject such doctrines as original sin, the Trinity, the incarnation, whether historic or mys-

tical, and the whole of natural theology, as of no religious value, and he denied the preexistence and miraculous birth of Jesus. He laid stress upon the historical character of Christianity, but held free views of inspiration, and admitted the most advanced criticism. His view of the atonement was essentially the same as the "moral influence" theory of liberal theologians. See the 'Life' by his son Otto (1892-6); Pfeiderer, 'The Development of Theology in Germany since Kant' (1890; German ed., enlarged, 1891); 'Die Ritschlsche Theologie kritisch beleuchtet' (1891); and Schon, 'Les Origines historiques de la Théologie de Ritschl' (1893).

Ritschl, Friedrich Wilhelm, German classical scholar: b. Thuringia 6 April 1806; d. Leipsic 9 Nov. 1876. He was educated at Leipsic and Halle, where he devoted himself to classical studies, and in 1832 was appointed extraordinary professor at Halle. He subsequently held professorships at Breslau and Bonn, and in 1865 accepted a call to Leipsic, where he remained until his death. His chief work is a critical edition of Plautus' Comedies (1848-54, incomplete; entirely remodeled edition, 1881-94). His other works include 'Parerga Plautina et Terentiana' (1845); 'Priscæ Latinitatis Monumenta Epigraphica' (1864); 'Opuscula Philologica.'

Rit'son, Joseph, English antiquarian: b. Stockton-on-Tees, England, 2 Oct. 1752; d. London 23 Sept. 1803. He studied law, became conveyancer in London and deputy high bailiff to the duchy of Lancaster. For many years he devoted his time to antiquarian researches and the editing of rare books, and he assisted Sir Walter Scott in preparing his work on the Border Minstrelsy. His works include: 'Observations on War-ton's History of English Poetry' (1782); 'Ancient Songs from the Time of King Henry II. to the Revolution' (1790); 'Ancient English Metrical Romances' (1802); etc. Consult: 'Letters of Joseph Ritson, with a Memoir by Sir Harris Nicolas' (1833).

Rittenhouse, rit'n-hows, Benjamin, American surveyor: b. Norriton Township, now Montgomery County, Pa., about 1740; d. Philadelphia 31 Aug. 1825. From 1776 to 1778 he was superintendent of a gun factory, maintained by the State of Pennsylvania. He sat in the Assembly of Pennsylvania from 1784 to 1788 and was appointed commissioner to survey the Schuylkill River in 1789. In 1792 he became associate judge of the court of common pleas of Montgomery County. His surveyor's chain made by order of Congress in 1796 has been the standard of the United States land office ever since. He was a brother of David Rittenhouse (q.v.).

Rittenhouse, David, American astronomer and mathematician: b. Germantown, Pa., 2 April 1732; d. Philadelphia 26 June 1796. His great-grandfather, Willem Rittinghuysen, a Mennonite, emigrated from Arnheim, in Holland, in 1688, and set up, on the banks of the Wissahickon Creek, the first paper mill in America. His mother, Elizabeth Williams, was from a Welsh Quaker family. When David was a small boy, the family moved to a farm in Montgomery County, and he lived the usual life of a country lad. From an uncle he inherited, when about 12, some books on calculation and geometry, and henceforth his life was determined. Mathematics and computation be-

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came the passion of the boy and the absorbing interest of the man. To these should be added a great facility in mechanical invention and execution. In his teens he began to make clocks of wood and metal, and his father set him up in the business of maker of mathematical instruments and clocks. He is said to have independently discovered the method of fluxions or the calculus when but 19, and to have foreseen its vast utility, before he heard of the claims of Leibnitz and Newton. A friend, Rev. Thomas Barton, furnished him with linguistic and scientific works and his intense assiduity made him a scholar.

In 1763 his fame as an accurate worker in science gave him his first public employment. He was appointed to lay out on the ground the 12-mile radius around Newcastle, which forms the boundary between Pennsylvania and Delaware. This he did most accurately with instruments of his own construction, and Mason and Dixon accepted his results as final. In 1769 he located the point where the 41st parallel of latitude, the boundary between Pennsylvania and New York, strikes the Delaware River. His scientific activities were incessant. In 1769 occurred the transit of Venus, then supposed to be the most reliable means of determining the distance to the sun. Rittenhouse had read a paper before the American Philosophical Society, with computations of the time of ingress and egress, and the Pennsylvania legislature had appropriated £200 toward the observations. He built an observatory near his home in Norriton, and, in company with a committee appointed by the Society, made the most exquisite preparations for the occasion. Everything came off beautifully, and after it was over he fainted. His results were the best obtained in the world, and the computed parallax of the sun the most accurate then known.

He invented the plan of placing spider lines in the focus of his telescope, an arrangement that has done more to make accurate measurements possible than almost anything else of the kind. In 1770 he completed his famous orrery based on computations of his own. This showed the movements of the planets and moons in elliptic orbits around their primaries, the phenomena of eclipses, and the relative places of the members of the solar system over a time of 5,000 years preceding or following. For this he received £300 from Princeton University, and a like sum from the legislature of Pennsylvania as a testimonial to his genius for a second orrery for the University of Pennsylvania. The first one was injured by the British troops in the Revolutionary War.

Then followed computations of the orbits of comets, surveys of the land between the Delaware and Susquehanna for canal purposes, calculations for almanacs, surveys for a series of dams to make the Schuylkill River navigable, and various papers on astronomy for the Philosophical Society. His fame extended to Europe and many honors came to him, while he was looked upon with profound respect and pride by his countrymen who could appreciate his work. He was most modest and simple in his tastes, and if his life could have been spent in the pursuit of science, it was fondly believed that the American Newton had been found. But he conceived that his country called for

service in another field. He was engineer and finally president of the Committee of Safety of his state during the Revolutionary War, and plunged into military problems with all his energy. In 1776 he was made a member of the Assembly of Pennsylvania, the earliest under the reorganized Revolutionary movement, and was active in the creation of the new constitution, the first for the State of Pennsylvania. No one took a more prominent part than he. In 1777 and for 12 successive years, he was elected state treasurer. He was also trustee of the Loan Office. Throughout the war his time was taken up with administrative duties which he disliked, but faithfully performed.

After the war, about five years were expended in determining the boundaries of Pennsylvania. The five degrees along Mason and Dixon's line were ascertained by observations on Jupiter's satellites at each end with instruments made by himself. He was also engaged in running the western and northern boundaries of his State, and at the appointment of Congress, in 1787, the line between New York and Massachusetts. From 1779 to 1782 he was professor of astronomy in the University of Pennsylvania and afterward trustee and vice-provost of that institution. In 1792 he was made director of the United States mint by President Washington. After three years of service, he resigned and returned to scientific work. He succeeded Franklin as president of the American Philosophical Society in 1790. Degrees were conferred upon him by the University of Pennsylvania, by Princeton and by William and Mary, and the Royal Society of London made him an honorary member. "We have supposed," said Thomas Jefferson, "Rittenhouse second to no astronomer living; that in genius he must be the first because he is self-taught."

He was an ardent Republican. He allied himself with the strong Revolutionary party and with the anti-Federalists after the war. He was president of a society organized to sympathize with the French Revolution and was a loyal member of the party which later under Jefferson introduced the extreme democracy of the reactionary period which followed Federalism. Whether he was in fault or not in his political affiliations will be differently judged, but posterity can unite in admiration for the self-educated scientist of the highest type and for the lovable, honorable, sincere gentleman.

His publications, about 20 in number, appeared in the Transactions of the American Philosophical Society. The most popular was an Oration on Astronomy. An interesting 'Eulogium' was delivered after his death by Dr. Benjamin Rush. His life was written by his nephew, William Barton, in 1813, and by James Renwick in Sparks' American Biography. A discriminating account of him, by S. W. Penny-packer, was issued in 1882.

ISAAC SHARPLESS,
President Haverford College.

Ritter, rit'ter, Frederic Louis, American musician and composer: b. Strasburg, Alsace, 22 June 1834; d. Antwerp, Belgium, 6 July 1891. He studied music at Paris with Georges Kastner, taught at the seminary at Fénéstrange, Lorraine, and in 1856 came to America and settled at Cincinnati. Here he organized the Cecilia

(choral) and Philharmonic (orchestral) societies. Removing to New York in 1861 he became the conductor of the Sacred Harmonic and the Arion Choral Societies. The first musical festival of note held in New York was given under his direction in 1867. That year he assumed the duties of the professorship of music at Vassar College, which position he held until his death. He was a prolific composer of vocal music such as solos and choruses, among which were musical settings for several Psalms, 'O Salutaris,' an 'Ave Maria,' a group of Persian songs, and more than 100 German lieder. He also wrote works for orchestra and piano-forte and was the author of 'A History of Music in the Form of Lectures' (1870-4); 'Music in England' (1883); 'Music in America' (1883); 'Manual of Musical History' (1886); and 'Musical Dictation' (1888).

Ritter, Heinrich, hin'rih rīt'tēr, German philosopher: b. Zerbst in Anhalt, 21 Nov. 1791; d. Göttingen 3 Feb. 1869. He studied at Halle, Göttingen and Berlin from 1811 to 1815, and in the last named year the calling out of the volunteers led him to France. On his return he devoted himself exclusively to philosophy, especially in the department of history, in which he adopted the method and critical views of Schleiermacher. He qualified himself at Berlin as a university teacher, and from 1824 held an extraordinary professorship in that city until he accepted a call to Kiel in 1833, whence in 1837 he removed to Göttingen, where he continued to occupy the university chair of philosophy till his death. Ritter's best works belong to the history of philosophy, his first in this department being an investigation into the doctrines of Empedocles in Wolf's 'Literarische Analekten' (1820). His 'History of Ionian Philosophy' (1821); 'History of the Pythagorean Philosophy' (1826), and 'Notes on the Philosophy of the Megarean School' in the Rheinisches Museum, are models of historical investigation on the principles of Schleiermacher. His historical masterpiece is the 'History of Philosophy' (1829-53), which deals with general history up to the time of Kant. It was supplemented by a 'Review of the History of German Philosophy from the Time of Kant' (1853).

Ritter, Karl, German geographer: b. Quedlinburg, Prussian Saxony, 7 Aug. 1779; d. Berlin 29 Sept. 1859. He was educated at Halle, resided for a considerable time at Göttingen, in order to avail himself of its library, in 1819 succeeded Schlosser as professor of history at the Frankfort Gymnasium, and in 1820 became professor extraordinary of geography at the University of Berlin, an office which he held with distinguished reputation for nearly 40 years. With Ritter may be said to have commenced a new epoch in geographical science; and a new department, that of comparative geography, claims him as its founder. His great work is 'Die Erdkunde im Verhältnisse zur Natur und Geschichte des Menschen' ('Geography in its Relations to Man's Nature and History'), the first two volumes of which appeared at Berlin in 1817-8, although it was afterward continued on a more extended plan, yet it was left incomplete, covering only Africa and Asia. It constitutes, so far as it extends, 19 vols. (1822-59), a vast repertory of valuable information rel-

ative to physical and general geography. Among other productions of Ritter may be mentioned 'Europa, ein geographisch-historisch-statistisches Gemälde' ('Europe Delineated Geographically, Historically, and Statistically,' 1807), and 'Die Stupas, oder die architektonischen Denkmäler an der indobaktrischen Königstrasse und die Kolosse von Bamyān' ('The Stupas, or Architectural Monuments on the Indo-Bactrian Highway and the Colossi of Bamyān,' 1838).

Ritual, in ecclesiastical usage, a manual containing the forms to be used by the priest in administering the sacraments, namely the communion (when given outside of the Mass), baptism, absolution, marriage and extreme unction; also in such rites as the churching of women, burial of the dead, blessing articles for religious uses, as water, candles, etc. The Roman Ritual now in universal use in the Latin Church was drawn up by order of Paul V., who, 1614, "counseled" all prelates to conform to its prescriptions exactly; but though the pope only counseled (*hortatur* is the word he employs in the bull *Apostolica Sedi*, a decree of the Congregation of Rites (1850) declares that the forms of the *Rituale Romanum* "affect the universal church." Before the issuance of the bull of Paul V. there were various ritual manuals authoritative in different countries or different episcopal jurisdictions. In the Eastern churches generally, as in the Greek Schismatical Church, the Ritual forms part of the general service book, the Euchologion, which corresponds to the Missal, the Pontifical and the Ritual of the Latin Church. The ritual of the Anglican Church is contained in the Prayer Book under the heads "Ministration of Baptism," "Order of Confirmation," etc.

Ritual of the Dead, one of the service books of the Roman Catholic Church in which are contained the prayers and the order of ceremonial used by that church in the administration of the sacrament and in certain other offices. The ritual occupies much the same position to the priest as the *Pontificale* does to the bishop. These directions are contained, in the case of the Anglican Church, in the Book of Common Prayer; in the Greek and some of the other Eastern churches the ritual is a part of the general collection. The Roman Catholic ritual now in use was made under the direction of the Council of Trent (Dec. 1545 to Dec. 1563), the need being felt for a unified ritual, to replace the various versions then in use. In 1614 Paul V. published an authoritative edition. This was often reprinted, and was revised and reissued by Benedict XIV. See BOOK OF THE DEAD.

Ritual Law, that portion of the law of Moses which prescribes the ceremonies of public religious worship, the manner of making trespass offerings, the procedure for the discovery of leprosy, for the purification of women after childbirth, the discrimination of things clean and unclean, etc. The ritual laws of the Hebrews are contained mostly in the books Exodus, Leviticus, Numbers and Deuteronomy.

Ritualism, a term designating the practices of a party in the Church of England and the Episcopalian Church in the United States and elsewhere, in surrounding the public worship with a variety of rites and ceremonies, and in

resuscitating certain features and usages of the Catholic Church in pre-Reformation times, such as the use of ornate eucharistic vestments, use of the sign of the cross, belief in the "Real Presence," prayers for the dead, treating the communion service as a real sacrifice, auricular confession, and many other beliefs and practices usually esteemed by Protestants as the insignia of "Romanism." By many, ritualism is held to be only another name for Puseyism and Tractarianism; but Dr. Pusey, at least, the reputed father of Puseyism, never adopted any of the practices of ritualism. The Ritualists defend their position against the charge that it is nothing but a revival of "Romanism" in the Protestant Church and that it is flagrantly inconsistent with the simplicity of Christian worship as portrayed in the books of the New Testament, by saying — what is undoubtedly true — that not all authoritative regulation of ritual is laid down in the New Testament, and that what is obligatory in ritual is to be learned from apostolic tradition. They allege, in explanation of the simplicity of primitive Christian worship, the secrecy and restraint to which the church was subjected through the ages of the persecution. All through that time the apostolic tradition was preserved by the church: on the accession of Constantine the ritual of the church assumed its natural beauty and proportions. And they cite the Anglican Book of Common Prayer in its original form as promulgated in the second year of Edward VI. (1549) as authorizing most of the practices now condemned by Protestants as ritualistic and "Romish." Their contention that the Episcopal Church of England, with its daughter churches, is historically committed to the practices for which the Ritualists are censured, need not be considered here: it will suffice briefly to state some of the peculiar rites and usages which distinguish the Ritualists from the mass of Protestants whether in the Episcopal or other churches. The Ritualists hold that the "altar" is a necessary part of Christian worship: the Book of Common Prayer, in the "order for the administration of the Lord's Supper," carefully avoids the word "altar" and says always "table." The Ritualists revived the practice of auricular confession and set up in their churches confession-boxes as in Roman Catholic churches. They brought back into use the eucharistic vestments — dalmatic, chasuble, cope, etc. The Puritans held the cross an abomination: the Ritualists set it on top of their churches and in the centre of the altar — and not only the cross but the crucifix. They restored also the use of incense in divine worship; and at the celebration of "the Mass" as they do not hesitate to call what in the Prayer Book is "the Lord's Supper" or "Holy Communion," they keep candles burning, as in Roman Catholic churches, even though the sun may be at meridian. And, what is more significant still, the Ritualists pay formal adoration to the "Real Presence" of Christ's body and blood, believed to underlie the species of bread and wine.

Ritualist, one who is zealous for strict observance of ritual; in particular, one who advocates the use of the rites of Catholic worship in the Established Church of England or in the Episcopal churches which derive from the Church of England. See RITUALISM.

Rivarol, Antoine, ăn twān rē-vā-rōl, French satirical and political writer: b. Bagnols, 26 June 1753; d. Berlin 11 April 1801. He was one of the celebrated wits of the 18th century, possessing distinction, elegance and an astonishing facility in the expression of his thoughts that early gave him a position in the salons and at the court of Paris. His first work, which obtained a prize at the Academy of Berlin, was 'Discours sur l'Universalité de la Langue Française' (1784). The same year he published a translation of Dante's 'Inferno.' Later appeared 'Lettres à M. Necker' and in collaboration with Champcenetz, 'Petit Almanach des grands Hommes' (1788), a satire on the authors of his day. Becoming an émigré in 1792, he lived at Brussels, London, Hamburg and finally at Berlin, his works at this period being 'Lettres au Duc de Brunswick'; 'Lettre à la Noblesse Française' (1792); 'Vie politique et privée du Général La Fayette' (1792); also a preliminary discourse to a French dictionary (1797). In 1828 was published under his name a dictionary of the French language which was not written by him. His collected works were edited by Chénedollé and Fayolle in 1808.

Rivas, rē-vās, Nicaragua, a town between Lake Nicaragua and the Pacific Ocean, slightly northwest of the surveyed route of the Nicaragua Canal, and on the high road to Granada. It occupies the site of a Nicaraos Indian village. Pop. 6,000.

Rivé-King, rē-va-kīng, Julie, American concert pianist: b. Cincinnati, Ohio, 31 Oct. 1859. She is the daughter of Léon and Caroline Rivé, the latter a musician and her first teacher, and was married in 1878 to F. H. King. She appeared first in concerts at the age of six. Later she was a pupil of Liszt. She has appeared in over 200 concerts with Theodore Thomas and 80 with Seidl, besides in many independent recitals. She ranks among the foremost solo-pianists in America.

River Dolphins. See PORPOISE.

River Falls, Wis., city in Pierce County; on the Kinnickinnick River, and on the Chicago & Northwestern; about 60 miles in direct line west of Eau Claire and about six miles from the Mississippi River. It was settled in 1850 by a colony from New York, incorporated in 1856 and chartered as a city in 1885. It is in a productive agricultural region, in which wheat is the principal crop. The chief manufacturing establishments are flour mills, wagon works, and starch factory. The trade is mostly in grain, flour, and vegetables. The principal public buildings are the six churches and the schools. River Falls is the seat of a State normal school, and a high school, and has two graded schools. The bank has a capital of \$25,000. The government is vested in a mayor, elected biennially, and a council of six members elected annually. The city owns and operates the waterworks, and the electric light plant. Pop. (1890) 1,783; (1900) 4,503; (1910 est.) 5,000.

River-hog, one of the African wild swine of the genus *Potamocharus*, separated from the typical pigs (*Sus*) by the existence of a horny outgrowth from a bony protuberance above the canine in the male. This has been compared by Beddard to the osseous horn-cores of the extinct *Dinocera*. Five species are recognized, one in

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Madagascar, and the others in South and West Africa. The best known are the gray bush-bark or bush-pig (*P. africanus*) of Cape Colony, and the red river-hog (*P. porcus*) of the West Coast, remarkable for its vivid rufous coloring and long penciled ears. These pigs lead a half-aquatic life along the marshy borders of sluggish streams and in dense forests, but do great damage to the native plantations in some parts of the country, whence they are constantly killed off. Consult 'Proceedings' Zool. Soc. London, 1894, p. 92.

River-terrace. See TERRACE.

Rivera, José Fructuoso, hō-sā' frook-too-ō'sō rē-vā'rā, Uruguayan soldier and politician: b. Paysandu, Uruguay, 1790; d. Montevideo, Uruguay, 13 Jan. 1854. He fought in the numerous civil wars, rose to leadership, and when Uruguay established her independence became in 1830 first president of the republic. In 1835 he was succeeded by Oribe, and in 1836 headed a revolt against the president, which resulted in a civil war of two years' duration. Oribe was forced to resign, and in 1838-42 Rivera again served as president. In the latter year, Oribe, aided by the Buenos Ayres dictator, Rosas, invaded Uruguay, and in 1843 began the famous nine years' siege of Montevideo. Rivera moved to meet him in the field, but in 1845 was defeated at India Muerta by Urquiza, an ally of Oribe. In 1853 Rivera aided Flores in deposing the recently elected president, Giro, and later became a member of the executive triumvirate.

Riverhead, N. Y., village, county-seat of Suffolk County; on the Peconic River, at the head of navigation, and on the Long Island railroad; 67 miles east of New York. The village was first settled in 1690, and its growth during the first century was slow; in 1729 it was made the county-seat. During the War of 1812 a skirmish between men from some British vessels and the American militia took place near the village and within the limits of the township. It has a variety of industrial establishments, including grist mills, a woolen mill, planing and molding mills, carriage works, soap factories, and an organ manufactory. It contains the county court-house, the agricultural fair buildings and grounds, and has a high school with a school library. Pop. (1890) 4,010; (1900) 4,503; (1910) 4,706.

Rivers (Fr., *rivière*; Span., *ribera*; It., *riviera*; Lat., *riparius*, from *ripa*, bank, of or belonging to a bank), bodies of water of considerable size flowing with perceptible currents in definite channels, and usually without cessation during the year. Some water courses are designated as rivers although their beds are dry a part of the year. Rivers, obeying the laws of gravity, their waters seek the lowest level and eventually reach the ocean. The regions having rivers which do not flow into the ocean either directly or indirectly are parts of the earth's surface where the evaporation is so great that no overflow of water results from precipitation. Usually the overflow of a river discharges into another river, and perhaps a second or even a third discharge is made before the waters reach the sea. The Republican River of Nebraska and Kansas flows into the Kansas River in the State of Kansas, and the Kansas River

flows into the Missouri; the Missouri into the Mississippi, and the Mississippi into the Gulf of Mexico, which last discharges its waters into the Atlantic Ocean through Florida Strait and Yucatan Channel.

Origin.—Rivers are usually formed by springs or the gradual melting of the ice and snow which perpetually cover the summits of all the most elevated ranges of mountains upon the globe. Springs and ice are themselves due to the precipitation of water from the atmosphere in the form of snow, rain, mist, or dew. These fill the springs, lakes, or other reservoirs from which rivers flow by the natural gravitation of water to a low level. The union of various springs, or of these meltings, forms rivulets; these last follow the declivity of the ground, and commonly fall at different stages into one great channel called a river, which at last discharges its waters into the sea or some great inland lake. A new made river at first usually flows over the surface until it has worn itself a channel; or it may follow some depression or deformity in a mountainous region. Rivers are swollen during their course by the rain which falls on the surface. In temperate climates the source of supply tends to greater equality in the volume of the river than in torrid regions, where the evaporation is great. In the former the rains are not only more equally distributed in point of time, but also from a more protracted source of supply; part of the rainfall sinks into the ground and forms springs, part forms rills which flow directly into the river, and part feeds those rills with the drainage of the saturated ground long after the rain has ceased. As mountainous regions abound in springs, most rivers commence from a chain of mountains; each side of a chain also has its springs, and the rivers which originate on one side flow in the opposite direction to those which rise on the other. As it is the property of water to follow the most precipitous descent that comes in its way, the courses of streams point out the various declivities of the earth's surface, and the line from which large rivers flow in contrary directions generally marks the highest parts of the earth. This line need not, however, be of any great height; in European Russia, for instance, where the rivers are very extensive, the line which separates their sources is very little above the level of the Baltic or of the Black Sea.

Changes in Form and Size.—As soon as the stream begins to flow, its channeling and the deepening of its trough commences. If no obstructions prevented, the water would go on enlarging the channel, by widening and deepening. The nature of the soil, the softness or hardness of the rocks along its course, the amount of sediment it carries in its waters, and where this sediment is deposited all contribute to change of form and size. The erosive action of rivers on their beds is continually exercised, especially in the early part of their course; where the channel broadens as they approach the sea it may almost cease. Remarkable instances of erosive action are almost everywhere to be observed; but in no case is such action more striking than in the cañons or river-gorges in the Colorado region of the United States. There the rivers have hollowed out for themselves channels that present almost perpendicular rock walls on either side rising to the

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height of 6,000 feet for hundreds of miles. Such action is also seen where there is a waterfall, in which case the water gradually wears away the rock at the place where the fall occurs, and thus causes the latter to recede, as Niagara Falls. In perhaps every case a river has had much to do with the formation of the valley in which it flows. Rivers are very permanent features in the earth's history, and in some cases have hollowed out a channel through a mountain range gradually elevated across their source.

The size of a river depends upon two main circumstances,—the extent and character of its drainage area, and the degree of humidity possessed by the climate of the region from which it draws its supplies,—the latter being often dependent upon prevalent winds blowing from the ocean. The peculiar position of the Andes Mountains with respect to the rest of South America, the fact that by very far the largest proportion of its running waters are drained off in one general direction, toward the Atlantic, and the humidity of the climate, all contribute to the immense size of the rivers. The Andes being placed so near the coast of the Pacific, the rivers which flow into the Pacific Ocean are small; while those which flow on the other side, having such an immense space to traverse, are increased into a vast volume before they reach the Atlantic. The physical conformations of some continents are unfavorable to the accumulation of such vast bodies of water as the rivers of South America. Europe is not of sufficient extent; Africa has a climate which causes rapid evaporation and abounds in sandy deserts. A large part of Asia has not the humidity of the Amazon region, and its vast interior lakes serve as receivers for some of the large streams. The arrangements of its mountains conduce to long and somewhat narrow drainage areas. As the river goes on from year to year, in most cases it cuts a trench below the original constructional channel, and in time forms what is called a consequent valley. By means of the new constructional troughs many of the constructional lakes and the rivers become continuous streams, that increase the length as well as the depth of the channel. Where the waters pass from a hard to a soft rock, or from a resistant to a weak part of the material through which it is channeling, a greater slope is formed making rapids (q.v.) or falls (q.v.) or cascades (q.v.). The angle of the slope depends upon the difference in the degree of resistance of the hard rock in the old channel as compared with the soft rock in the formation channel. Gradually the channel is cut down close to the sea-level or base-level, and its course is over a gentle, gradual slope. The depth of the channel depends upon the dryness of the climate, softness of the rock, height of the land, and the volume of the stream. The dry climate really lessens the volume of the stream, and consequently it cannot force its way with the rapidity of a stream with greater volume even if the widths of the channels are equal. The river flowing through a region of hard rock will cut a deeper valley in a given time than the river of the same size and volume flowing through a region of soft rock; the latter will have a mass of detritus, an accumulation of waste from the weak rock, and it will need a vast volume of water or a steep

grade to do the same amount of channeling as the first mentioned river. Rivers flowing over comparatively low land, with drainage areas not much above the base-level have shallow channels, as in the southeastern part of the United States, especially in Florida. A river with a large volume of water has more power to carry off sediment, and even where the slope is gentle its momentum is greater than in that of the stream of a small volume of water. There are two causes for the shallow channels of the long rivers of the plains east of the Rocky Mountains; the dryness of the climate and the soft rock material through which they pass.

After a river has cut its channel to the base-line, then its grading really begins, the inequalities gradually disappear, or would disappear if there were no obstructions to the regular work. The constructional lakes and the waterfalls gradually disappear. The constructional lakes may disappear, but if the amount of detritus is large the channels lower down a stream, with a slight grade, may be filled, and thus the water will flow over a bed elevated above what was once its channel. Such channels exist in Ohio and in the plains of Lombardy. Any change in the depression or uplift of the land, whether from volcanic or other causes, will cause some change in the river. In various parts of Europe and the eastern part of North America, rivers have changed because of increase of evaporation, caused by the continued deforestation of their basins. New rivers often appear in the drainage area of a well defined river. There are several causes for this change: the consequent valley formed by the original stream will, in places, have a weak rock-mass through which the water will break and a lateral channel or ravine will be formed. The valleys formed by such streams are called subsequent valleys and the streams themselves are called subsequent streams.

The main stream with all the lateral streams and all tributaries, whether lakes or rivers, is called a river system. The land drained by a river system is called its basin. The system is usually known by the name of the main stream or trunk.

The rate of fall of many of the large rivers is not great. The Amazon has a descent of only $10\frac{1}{2}$ feet in 600 miles of its course—that is, one twenty-seventh part of an inch for every 1,000 feet of that distance. The Loire, in France, between Pouilly and Briare, falls one foot in 7,500 feet, but between Briare and Orleans only one foot in 13,596 feet. Even the rapid Rhine has a descent of no more than four feet in one mile between Schaffhausen and Strasburg, and of two feet between the latter place and the borders of Holland. The glaciers in France show a change in volume, and a consequent change in the size and rate of fall of the glacier-fed rivers. See NIAGARA FALLS; WATERFALLS.

Watersheds or Divides.—The line which separates the waters which flow into different rivers or different systems is called the watershed or the divide. The continental divide in the United States is the line which parts or separates the streams which flow into the Pacific from those which flow into the Gulf of Mexico through the Mississippi. Divides change from various causes. The subsequent rivers sometimes take the water from one system to

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another. The gradual removal of a constructional lake may change the divide, as in New York State, between the Mohawk River and Lake Ontario, in the Northwest between the Red River of the North and the Mississippi. The divides in many places are very low, as between the Amazon and Orinoco, and the Amazon and the Paraguay. The Orinoco at some distant period reached the basin of the Amazon, and has been subsequently connected with it through what is now an important branch, the Cassiquiare, which after a course of 120 miles from the main river discharges itself into the Rio Negro, a branch of the Amazon; and as the navigable waters of the Amazon approach within three miles to those of the Paraguay, there is with only this interruption a continuous communication by navigable rivers from the mouth of the Orinoco, in lat. 9° N., to the mouth of the Paraguay, in lat. 35° S.

Flood-Plains.—For various reasons many rivers overflow their banks at annual periods, others at irregular intervals. Such rivers usually carry a large amount of silt which at the time of an overflow is deposited on the land, thus enriching it. Great damage sometimes results from this overflow (see **LEVEES**; **MISSISSIPPI**), and various means have been devised to protect the lands adjacent to such rivers from inundation. The flood-plains of the Nile are noted for their fertility; the Mississippi, Amazon, Ganges, and many others have extensive flood-plains. The large rivers of Siberia have vast flood-plains caused by the thaws at the sources of the rivers when the lower portions are closed by ice. The descending waters sweep over the frozen surface carrying with them vast quantities of soil, detritus, and even forests. The Mackenzie in North America has flood-plains from the same sources as the Siberian rivers.

Mouths of Rivers.—The river which enters the ocean may have its channel submerged and the mouth becomes an estuary, or the tidal wave may crowd back its waters and the mouth becomes a fiord. In either case there is a constant battle for supremacy between the fresh water from the land-mass and the salt waters of the sea. Some of the sediment of the rivers is brought to the sea and either carried out into the ocean or deposited at the mouth of the river, where they form deltas. In some cases, as the Mississippi, the delta grows rapidly, extends out into the sea and becomes a part of the land-mass. The sediment annually brought down the Mississippi has been estimated as equal to a deposit of a foot in thickness over 12 square miles. The waters of the Ganges and Brahmaputra come more highly charged with sediment on account of their more rapid descent and the more violent rains that fall about their sources, and their deposits exceed many times those of the Mississippi. The sediments are spread out to a distance of 100 miles or more from the land, the waters of the Bay of Bengal being discolored by them even at this great distance. The quantity annually discharged from the mouth of the river has been computed equal to a layer one foot thick over a tract of 225 square miles. The Nile has a vast delta. The Mississippi, Nile, Ganges, Po, and many other rivers enter the sea by several channels. The Amazon enters by only one large channel, divided by an island, but the river widens out into a bay 180 miles wide. The delta-lands are

very fertile, and where the river channels have assumed stability, deltas have become valuable additions to the land-mass.

Economic Relation of Rivers.—The effect rivers have in supplying moisture to the adjacent lands, either by natural or artificial (irrigation) means is recognized by all nations. Their uses as contributing to the healthfulness of the climate and to modifications of temperature are well known. In the early history of all the nations on the globe, the waterways were the great thoroughfares which furnished means of intercommunication, and the rivers were largely instrumental in determining the location of the great commercial and industrial centres of the world. The great rivers of Europe and Asia, such as the Rhine, Danube, Volga, Indus, Ganges, Brahmaputra, Yangtze, and Ob, afford access to the sea to enormous populations. The Amazon, with its plain track extending for nearly 3,000 miles, is in many ways less like a river than a fresh inland sea; but the Mississippi and Saint Lawrence, though less extensive, are of greater value for carrying sea traffic to inland places. In their upper valley tracts, rivers are of use chiefly for transporting timber and driving machinery. It is interesting to note that in Switzerland, Norway, and Sweden, where there is no coal, there exist exceptional facilities for the use of water power on account of numerous mountain torrents.

LAW OF RIVERS.

General.—In law a body of water having a uniform current is generally termed a river. It consists of the bed, the water, and the banks or shores according as the stream is non-tidal or tidal. The law applicable to rivers and their use depends upon the country having jurisdiction over them. In the United States the use of navigable rivers is regulated by the laws of the United States, and by the legislatures of the States through which they flow. No general statement that is applicable to all streams, and which governs the use of all streams, can be made, and navigable and unnavigable rivers are not always subject to the same rules. In the United States, in the most approved and important sense of the term, navigable waters include all those having a channel which is useful for commerce. Such waters are public highways by common right. It has been said in construing the common law and in some of the earlier decisions of the courts that by navigable waters are meant all those in which there is a flow or re-flow of the tide. This definition may have been proper in England where there is no river of any considerable importance which has not a flow of the tide, but it would be unreasonable, in fact it cannot be applied in the United States where there are large rivers like the Mississippi, the Ohio, the Allegheny, the Delaware, the Hudson, the Schuylkill, the Missouri, the Columbia, and others that are very important for the purposes of navigation, and over which large business interests are transacted. To be navigable rivers, in the legal sense, commerce must be carried on over them which is of a valuable character. It is not necessary, however, that this commerce be carried on by means of boats: waters over which valuable commerce can be carried on are public highways for the purpose, even if they are used only for floating logs and rafts. Most of the authorities in America limit

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the term navigable waters to waters having an inherent capacity for navigation. Whether a river is navigable or not is generally a conclusion of fact and can be established by proof; but the courts in some States take judicial notice of the fact that some streams are navigable. In common law a distinction was made between waters navigable in law and those navigable in fact; those navigable in law being tide waters. The term is still used in this sense in England. By the civil law, waters that are in fact navigable are such in law, and a navigable river is defined as a *statio itinere navigio* (a place or way for navigation). In the development of American law the tendency of the courts has been toward the adoption of the civil law doctrines. Among navigable waters are two classes, termed Public and Semi-Public. The basis of classification is ownership. In public waters the soil beneath them is common property. The public have the right of navigation and all rights incident to ownership. Among them are fishing, gathering ice, sea-weed, sand, gravel, etc. All tide waters, including the sea and its arms and tidal rivers, belong to this class, and in many of the States all fresh-water rivers and lakes which have a capacity for valuable floatage are public. The non-tidal waters and the soil under them are private property, although the interest of the owner is qualified by being subject to the right of the public to pass over them.

Jurisdiction.—The right of navigation is subject to the control of the government, and the government has the right to improve rivers and harbors. In England this power was vested in Parliament. In the United States the authority of Congress under the commercial clause of the Constitution is paramount. In the absence of Congressional action, the power of the State legislatures is supreme; they may direct the improvements of navigable rivers, and may authorize improvements by individuals and by private corporations, and may levy tolls. Waters which lie within the borders of different States are generally subject to the concurrent jurisdiction of the States. The territory of States and nations when bounded by rivers, extends, unless otherwise agreed upon, to the centre of the streams.

Public Easement of Passage.—The public have the right of passage over all streams which have a capacity for that purpose, and this includes the right of navigation in boats and vessels, and of floatage as in the case of rafts and logs, and of travel over the ice. In common law the right to navigate waters above the tide was acquired by using the same. Now it may be granted by express act of legislature, but it is generally regarded as an inherent public right needing no legislative sanction. The legislatures of the States having jurisdiction, and Congress may make rivers and streams public highways for particular purposes when they are not public highways or navigable for other purposes. For instance, the Legislature may make a river a public highway for the purpose of floating logs, although it cannot be navigated by boats or vessels.

Use of Banks and Shores.—By the civil law the public have the right to use banks and shores of navigable rivers as appurtenant to the right of passage, and this is true of the States where that system prevails; but under the

common law the right to use the shores and banks by navigators was limited to high water mark and the right to pass over the waters does not include the use of banks for general purposes. But the public have the right of anchoring and of mooring on the banks against all except the owners of the banks. There is no public right at common law of towing on the banks. The owners of stranded property may go upon the banks for the purpose of taking it. In the use of rivers for navigation, the boats going down stream have a right to the centre of the stream or the centre of the current, and those going up stream must keep to the sides in passing. A descending boat may keep to the shore, but if she meets an ascending boat hugging the same shore and signaling her intention of keeping the shore, the boat going down stream must keep to the middle of the river. The rule is for the protection of vessels navigating up and down rivers crowded with boats to hold to the centre as nearly as possible. The rule both of statute and the general laws of navigation, which requires steamboats approaching one another to turn to the right applies to steamboats crossing a river, and ferry-boats crossing rivers making frequent trips, are obliged to use great care to avoid other sailing craft. Steamboats must keep out of the way of barges and flat boats floating down the river guided only by oars.

Rivers not Navigable.—Rights of Owners.—When a river that is not navigable forms the boundary of property, one half usually belongs to one proprietor and the other half to the other, the centre of the stream being the line between the owners of the lands on each side, and when the land on both sides belongs to one owner he is then the owner of the whole bed of the stream. This rule of law refers to the land under the water, and it is the property of the riparian owner as much as the banks of the river. The owner of the land has not an absolute ownership of the water, but he can use it for necessary purposes, as for the use of his family and house and to water his stock. If he takes more than the usual quantity and for such purposes as are not necessary, he is liable for damages to riparian owners farther down the stream in case they suffer damages. One owner of the land cannot change the bed of the stream to the injury of other owners; but if the line be changed slowly by accretion at one side, the line of ownership will still follow the centre of the stream. The rule might be different if, for any unforeseen and uncontrollable cause, the stream should burst its banks and make a new channel in a different place.

Fishing.—Each riparian owner has the right to fish in the waters on his own side of the river, subject to the fishing laws. It is customary, however, for owners of opposite sides of rivers to allow each to fish in the whole stream, for the convenience of both parties. Where the river bed is owned by the public and the river is navigable any person has a right to fish.

Accretions.—The owner of the land along the side of and under a river has the right to all deposits of alluvium along and upon his land. If an island is formed by accretions in an unnavigable stream, the ownership will be determined by the *filum aquae*, or centre of the stream, and it will belong to the parties owning

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the land on the side of the line on which it is formed. If the island is on the line, each will own his proportionate share.

Bridges.—Congress has power to authorize the erection of bridges over navigable rivers; the power may be exercised and authority given even when the bridges obstruct to a certain extent the free navigation of the rivers. States also have power to authorize the building of bridges over navigable waters within their boundaries, although they may to a certain extent interfere with navigation. This power in the States, however, is subject to the exercise of the power of Congress to regulate navigation. The proposition has come to be recognized as not disputable that but for the power granted by the Constitution to Congress, the State Legislatures would have as full and entire control of the waters of their several States as they have over the land. The States reserve all power not granted to Congress. The sovereignty over the waters of the States vests in Congress and in the several State Legislatures. Congress and the State Legislatures can provide for the erection and maintenance of draw-bridges over navigable rivers, and provide for the safe passage of vessels in the draws.

Boundaries.—When land along the bank of a river is described as being bounded on the bank or shore instead of the centre of the stream, then low water mark on the shore will usually be the boundary line. Where land is bounded by a common law navigable stream, that is, one in which the tide ebbs and flows, the boundary is the high water mark on the shore, and in some States in which there are large rivers that are navigable, although the tide does not ebb and flow, the boundary line is held to be low water mark. The proprietor has a right subject to government supervision to erect wharves and piers extending to low water mark or into the channel of the stream. In deciding what is low water mark, the ordinary rise and fall of the water is taken into account. There is not a unanimity of legal opinion in all the States upon the subject of the ownership of the beds of streams.

Dams.—The owner of land on both sides of a stream not navigable may erect a dam and swell the water of the stream or form a pond up to the line of the land of the next owner up the stream. An owner of but one bank cannot, without permission, erect a dam beyond the thread of the river. The erection of dams has been encouraged by the legislatures in many of the States on the ground of public policy. The right to erect dams has been given to riparian owners even when they flow the lands above them, and in some cases permission has been given to riparian owners to erect dams across the stream, although they owned land only upon one side. In these cases the statutes authorizing the erection of such dams have provided the method of assessing and collecting damages. Riparian owners on navigable streams, whether navigable by nature, or declared to be public highways by the legislatures of the States through which they flow, cannot erect dams across such streams without permission of the legislature having jurisdiction, or Congress. This permission is granted in some States by general law, and in others, as in New York, by special laws. The legislatures in granting permission to erect dams always

provide for ordinary navigation and for the maintenance of fishways. The right given by legislatures and by Congress to erect dams is not a protection against injuries to private owners. Such owners have a right to collect damages.

Ferries.—A ferry franchise is a right to transport passengers and property across a stream and to land at a particular place on its bank. In the United States this right is established by legislative authority. It is the creature of a sovereign power and no one can exercise it without the consent of the State. It is within the control of the government. In England the right was granted by the Crown, or founded upon prescription. A ferry franchise is real estate and can be sold like any other real estate.

Fishing.—Ordinarily any person may take fish out of navigable streams if he can do so without trespassing upon the lands of private owners. In most of the States of the United States as at common law, the exclusive right to fish is in the owners of the banks of rivers that are not navigable unless otherwise appropriated by statute. This right, however, is subject to legislative control. The preservation of fish in the waters of a State is of such public concern as to fall within the domain of legislative power. No owners of land have the right to obstruct the free passage of fish up and down the streams. The legislatures have the right to regulate the taking of fish from private rivers, which are unquestionably private property.

Floods.—Riparian owners who collect water on their land must keep such water under control at their peril, and dams erected for the purpose of confining water or creating ponds, must be constructed with such care and skill as to make them capable of resisting usual and ordinary floods.

Ice.—Water congealed is ice. Ice formed upon private waters, and that includes rivers owned by individuals, is real estate and is the property of the owner of the soil over which it is formed. In some of the States, however, as in Michigan, it is held as personal property and can be sold as personal property. After it is cut and removed it is always personal property. The owners of land bordering upon navigable streams in States where they are held to be public property, have no title to the ice which forms on such streams; such ice belongs to the first person who appropriates it, but generally ice forming upon private fresh-water streams belongs exclusively to the riparian proprietors and they may prevent others from removing it and maintain trespass against those who cut it without permission.

Irrigation.—The right to take water from streams passing over land owned by individuals is regulated by law, and differs in different States. The right, however, is generally recognized that there may be a reasonable appropriation, but no total diversion of the water.

When the State or the government intervenes and takes control of rivers for the purposes of irrigation, then the streams are to be used according to the laws enacted for the purpose. This is so as to the use of all rivers that can be used for the general good of the public. The courts have jurisdiction over questions arising out of the use of rivers. The United States admiralty courts have jurisdic-

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tion over causes of action arising in the large rivers as they do in the Great Lakes and the sea and coast waters.

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Riverside, Cal., city and county-seat of Riverside County: on the Santa Fe, Southern Pacific, and Salt Lake R.R.'s; about 60 miles east of Los Angeles. It was founded in 1870 by settlers largely from the New England States and New York, and was incorporated as a city in 1886.

Riverside is famous as the largest citrus producing and shipping point in the world, the annual output of the citrus fruits in Riverside County being over 8,000 cars, of which something over 1,000 cars are lemons, the balance being oranges (nearly 6,000 cars of this fruit are shipped from the city of Riverside alone). There are about 40 packing houses in the city where oranges and lemons are shipped, employing over 1500 persons at the height of the season. Alfalfa and deciduous fruits are also successfully grown, and there is a large grain-producing area in the county.

Riverside has one of the most extensive and complete irrigation systems in southern California. The climate is remarkably healthful and the place is famous as a health resort. The architecture of the public buildings has been largely developed along Mission lines, and among the famous buildings of this character are the Glenwood Hotel, the Carnegie library and the high school building. The courthouse is a single-story building built along classic lines, all on the ground floor, and cost \$250,000. Riverside is the seat of Sherman Institute, a United States Indian School, which has over 600 pupils.

There are three banks with a combined capital of \$250,000, and deposits of about \$3,000,000. The government of the city is vested in a board of trustees of five members, two chosen at one election and three at the next, elections occurring every two years. Pop. (1910) 15,212.

E. P. CLARKE,
Editor 'Daily Press.'

Rives, rêvz, Alfred Landon, American engineer, son of William Cabell Rives (q.v.) and father of Amélie Rives: b. Paris, France, 25 March 1830; d. 1903. He was educated at the University of Virginia and at the Ecole des Ponts et Chaussées, Paris, where he was graduated in 1854. He was assistant engineer in completing the Capitol at Washington, was engaged on the aqueduct there, and later was in charge of the United States survey for improving the Potomac River. He was colonel of engineers in the Confederate army during the Civil War, and was afterward manager of various railways and engineering enterprises.

Rives, Amélie. See TROUBETSKOY, A. R.

Rives, Hallie Ermini, American novelist, b. Christian County, Ky., 2 May 1876. She has published: 'Smoking Flax' (1896); 'As the Hart Panteth' (1896); 'A Furnace of Earth' (1900); 'Hearts Courageous' (1902); etc.

Rives, William Cabell, American legislator and diplomat: b. Nelson County, Va., 4 May 1793; d. near Charlottesville, Va., 26 April 1868. He was educated at Hampden-Sidney and William and Mary colleges, studied law, and in 1816 was a member of the Virginia constitutional convention. In 1817-19 and in 1822 he served in the State legislature, and in 1823-9 was a member of Congress. He was minister to France in 1829-32, and in that capacity negotiated the treaty of indemnity in 1831. He served in the United States Senate in 1832-4, 1835-45, and in 1849-53 was again minister to France. He was a member of the peace conference at Washington in 1861, and after the secession of the South sat in the provisional congress at Montgomery, Ala. He published 'Life and Times of James Madison' (1859-69).

Riveting Machines. See METAL WORKING MACHINERY.

Riviera, rê-vê-â-râ, a district bordering the Mediterranean coast, partly in France, partly in Italy, with Genoa as its central point. It extends to Spezzia on the east and Nice on the west, and is a favorite winter resort of invalids and others. The whole coast is traversed by a road and by a railway.

Rivière, rê-vê-âr', Briton, English painter: b. London, England, 14 Aug. 1840. He studied art under his father, a drawing master, worked at illustrating for many English and American publications and exhibited at the Royal Academy for the first time in 1864. He was elected A. R. A. in 1878, and R. A. in 1881. Among his most notable pictures, many of which have been engraved, are: 'Strayed from the Flock'; 'The Lost Sheep'; 'Legend of St. Patrick'; 'An Anxious Moment'; 'Circe'; 'Giants at Play'; 'Actæon'; 'Væ Victis'; 'Rizpah'; 'A Fool and His Folly'; etc. He is also known as a sculptor by his 'Anatomical Lion' (1888); 'A Dying King' (a lion, 1894); and 'The Last Arrow' (a lion-hunting scene, 1896).

Rivière du Loup, rê-vê-âr dü loo. See LOUISEVILLE.

Riv'ington, James, American printer: b. London about 1724; d. New York 4 July 1802. Early in life he was a bookseller in London, but in 1760 came to America, and opened a shop in Philadelphia, then in 1761 established himself in New York, and on 22 April 1773 began the publication of a newspaper entitled the 'New York Gazetteer, or the Connecticut, New Jersey, Hudson River, and Quebec Advertiser.' It was Royalist in sympathies and circulated among the Tories and gave to its publisher a position of some prominence. His affairs seem to have been under investigation by both the Provincial and Continental congresses, and he himself placed in temporary confinement. In November 1775, in consequence of his constant assaults upon the patriots, and especially Captain Sears, that officer came from Connecticut with a company of horsemen, proceeded to Rivington's printing office, destroyed the press, and converted the types into bullets. Rivington then went to England, and being appointed king's printer in New York, returned with a new press after the city had fallen into the hands of the British, and in October 1777 resumed the publication of his paper under the old title, soon changed to 'Rivington's New York Loyal Ga-



THE ROAD BUILDER.



THE GOOD ROADS TRAIN.



GRADER AT WORK.

zette,' and on 13 December to the 'Royal Gazette.' About 1781, when the success of the British was becoming very doubtful, he played the part of a spy, furnishing Washington with important information. When therefore New York was evacuated, Rivington remained in the city and changed the title of his paper to 'Rivington's New York Gazette and Universal Advertiser.' The paper finally suspended publication in 1783, and he passed the remainder of his life in comparative poverty.

Rix, Julian, American painter: b. California 1851; d. New York 24 Nov. 1903. He used to say that he was "a pupil of nature," and appears to have had no regular academic training. He came to New York in 1888, and his work immediately attracted attention by its marked personal qualities. His California landscapes have been familiar ever since to all visitors to the exhibitions. His best paintings, among which are scenes in the Maine woods, were produced during the last five years of his life.

Rix Dollar, the English way of writing the names of different silver coins used in various European countries, as the *rigsdaler* of Denmark = 53 cents; the Swedish *riksdaler* = 27 cents.

Rizal, José, hō-sā' rē-thāl', Filipino patriot and author: b. Calamba, province of La Laguna, Luzon; d. Manila 30 Dec. 1896. He studied medicine at Manila, and was graduated from the University of Madrid as doctor in medicine and philosophy; studied farther in Paris, Heidelberg, Leipsic, and Berlin; made researches in philology and ethnology; and was elected a member of the Berlin Anthropological Society. Having returned to the Philippines, he was soon compelled to emigrate, owing to the hatred visited upon him by the old Spanish party on account of his story, 'Noli Me Tangere,' descriptive of political conditions in the Philippines. He then resided in Japan, North America, and London, where he prepared an edition of Morga's 'Sucesos de las Islas Filipinas,' originally printed in Mexico in 1609. On the continent he wrote another political novel, 'El Filibusterismo.' Subsequently he practised medicine at Hong Kong, and went to North Borneo, where he purposed to establish an agricultural colony of Filipinos. Though he had obtained permission to visit the Philippines, he was arrested on arrival there, and banished to Dopitan. On the outbreak of the native insurrection against Spain, he was accused of being its instigator; and on a third trial was condemned and shot. The proceedings against him have been described as farcical. He was undoubtedly the most talented Filipino of recent times.

Rizal, rē-thāl', Philippines, a province of the island of Luzon, formed by the consolidation of the former province of Manila (excepting the city of Manila) and the district of Morong, bounded on the east by the province of Infanta and the Bay Lagoon, and on the west by the Bay of Manila; area, 1,026 square miles. The surface, except that part of the former province of Manila which lies south of the Pasig River (q.v.), is mountainous, traversed by a number of short irregular ranges. There are many plains which, though fertile, are often inundated by the Bay Lagoon to the destruction of crops. In the western part of the province, the betel is grown extensively, especially in the

vicinity of the town of Pasay; other products of the province are rice, sugar, corn, and tobacco; there are also extensive forests. A fine variety of building stone is quarried on the island of Talim, in the Bay Lagoon. The industries other than agriculture include lumbering, fishing, and the manufacture of lime, mats, and clothing for native wear. The trade of the province naturally concentrates at the city of Manila, and the railroad from Manila to Dagupan, numerous roads, and the waters of the Bay Lagoon and the Pasig River provide means of communication between the different parts of Rizal and Manila. The province was created and civil government instituted in June 1901. Pop. 246,940.

Rizzi, rēt'sē, Antonio. See RICCI, ANTONIO.

Roach, rōch, John, American shipbuilder: b. Mitchelstown, Ireland, 1815; d. New York 10 Jan 1887. He came to this country in 1829, obtained employment in various iron works and foundries, became a machinist and finally erected a foundry of his own. Later he established the Ætna Iron Works, where he constructed the first compound engines built in the United States, and also built the largest engines which had been made in the country at that time. In 1871 he purchased the Rainer shipyards at Chester, Pa., enlarged the establishment until its value was estimated at \$2,000,000, and under the name of the Delaware River Iron Shipbuilding and Engine Works, of which he was entire owner, built a large number of merchantmen and also constructed the first ships for the new United States navy, among them the cruisers Atlanta, Boston, and Chicago, and the despatch-boat Dolphin.

Roach, a small European fresh-water fish (*Leuciscus rutila*), of the family *Cyprinidæ*, related to the dace, chub, etc., and a favorite of anglers, because so much skill is needed in hooking it. It rarely weighs more than a pound, and is grayish or bluish green on the upper parts, lightening into lustrous white on the abdomen.

Roach, an insect. See COCKROACH.

Road-runner, a bird. See CHAPARRAL-COCK.

Roads, Improvement of, the rural highways of America are poor, probably the poorest that prevail in any country which has reached so high a state of civilization. Americans have excelled their competitors in other countries in nearly all industrial pursuits and methods, and have produced nearly everything required for the advancement of civilization in greater abundance and greater perfection than is to be found elsewhere in the world. The deficient highway system of the United States is now receiving the earnest attention of the people and they will soon excel in good roads as they have already done in so many other lines of development. In extenuation of the existing condition it must be remembered that the territory is extensive, and the mileage necessarily great. Much of the country is still new, and, in the older States, the improper location of many roads has been a hindrance to their permanent improvement because it is evident to the people in many cases that the permanent improvement of these mislocated roads would result in a loss of money, and, therefore, they are inclined to wait for a

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re-location. In the western country roads are mostly located on section lines running with the cardinal points of the compass east, west, north, and south, one mile apart; but in the older States roads were not located on section lines nor on scientific principles.

Some people object to the disadvantages in the western country that result from following section lines, because sometimes they run against obstructions. But it is better to have roads located on section lines, as they are in the West, than to have them located at random, as they are in the East, where they are seldom direct in their course. There are many places in the old States of the East where you will not see a road, nor a fence, nor a property line, nor a building nor an object of any kind erected or located by the hand of man that corresponds with any of the cardinal points of the compass. The lack of any uniform principle in the location of the permanent improvements in a country leads to circuitous roads and needless labor in a community. In following section lines in the West some of the roads may be wrongly located, but, owing to the absence of any system in the East, nearly all are wrongly located.

In addition to the ordinary difficulties encountered in so vast a work as permanently improving the highways of a great country, it has been supposed by many of the people that the railway system, which has been developed to such a remarkable extent in this country, would prove to be a sort of substitute for the ordinary highway system. President Roosevelt, speaking to this point in an address which he delivered before the National Good Roads Convention at Saint Louis, Mo., 29 April 1903, said:

. . . Of course, during the last century there has been an altogether phenomenal growth in one kind of road, wholly unknown to the people of old—the iron road. The railway is of course something purely modern. Now, a great many excellent people have proceeded upon the assumption that having good railways was a substitute for having good highways. A more untenable position can not be imagined. (Loud applause.) What the railway does is to develop the country, and of course this development implies the need of more and better roads.

In the United States the composite nature of the government has often led to a doubt as to who should have jurisdiction of the roads and who should bear the cost of their improvement. Some have thought that the United States government should assume the burden, and, in the early part of the 19th century, it built a great national road from Cumberland, Md., to Saint Louis, Mo., and other national roads of less importance. (See *ROADS AND HIGHWAYS*.) Some have thought that the States should assume jurisdiction and bear the burden of cost required for improvement, and this is now being done to a great extent in New England and New York. But the prevailing opinion of the people heretofore has been that the counties or local communities should maintain jurisdiction and bear the burden of cost. So, for generations the people living in the rural districts and owning the agricultural lands have borne the entire burden and have made substantially all the roads of this country. This is a burden, however, that rests too heavily on the rural communities and which they are either unable or unwilling to bear, and, as a result of this fact, all permanent improvement has been retarded. We are now

passing through in this country what England passed through 200 years ago, that is to say, we are trying to require a portion of the community—those living in the rural districts—to build and maintain the roads for the use of all the people. This is an unjust proposition that cannot be maintained successfully in this country any more than in England or other European countries. Macaulay, in his 'History of England,' after describing the almost impassable condition of the rural highways of England during the closing years of the 17th century, says:

One chief cause of the badness of the roads seems to have been the defective state of the law. Every parish was bound to repair the highways which passed through it. The peasantry were forced to give their gratuitous labor six days in the year. If this was not sufficient, hired labor was employed, and the expense was met by a parochial rate. That a route connecting two great towns, which have a large and thriving trade with each other, should be maintained at the cost of the rural population scattered between them is obviously unjust; and this injustice was peculiarly glaring in the case of the great North road, which traversed very poor and thinly inhabited districts, and joined very rich and populous districts. Indeed it was not in the power of the parishes of Huntingdonshire to mend a highway worn by the constant traffic between the West Riding of Yorkshire and London. Soon after the Restoration this grievance attracted the notice of Parliament; and an act, the first of our many turnpike acts, was passed, imposing a small toll on travellers and goods, for the purpose of keeping some parts of this important line of communication in good repair. This innovation, however, excited many murmurs; and the other great avenues to the capital were long left under the old system. A change was at length effected, but not without much difficulty. For unjust and absurd taxation to which men are accustomed is often borne far more willingly than the most reasonable impost which is new. It was not till many toll bars had been violently pulled down, till the troops had in many districts been forced to act against the people, and till much blood had been shed, that a good system was introduced. By slow degrees reason triumphed over prejudice, and our island is now crossed in every direction by nearly thirty thousand miles of turnpike road.

In a government having a composite nature like that of the United States it is not always easy to determine just what part the General Government, the State government, and the local government should respectively take in carrying out highway work, though it is generally admitted that there should be co-operation among them all. Leaders in State politics, governors, and other high officials, are very reluctant to recommend to the people that they levy taxes or issue bonds sufficient to meet the great expense of making the roads what they should be. For the past 100 years the leaders in the various States have been reluctant to recommend that their States assume the burden of cost which is necessary. As a result of this policy the entire burden finally fell on the local communities, that is, the counties, parishes, townships, and districts; so it is true as a general rule and with slight exception that all the rural highways of America have been produced by the farmers of this country, the general theory and practice being that the people in the cities should pave their streets and the people in the country should build and maintain their roads. But this burden has rested so heavily upon the shoulders of the agriculturists that they have not been able to make the progress which is required in order that our highway system may keep pace with our industrial development. It seems to those who have studied the question that the burden is too heavy for the agriculturists to bear, especially in view of the decline in land and agricultural

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1. Object Lesson Road, built by United States Government. Material, ordinary earth.
2. Typical State Road in New Jersey, built under the State aid plan by Hon. H. I. Budd, State Highway Commissioner.

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products within the last 25 years. And the case appears stronger when you consider that during the last 25 years there has been a most remarkable concentration of population and wealth in the great cities. In all of the States east of the Mississippi and north of the Ohio a majority of the people are living in cities and much more than half of the wealth is concentrated there. If the policy is pursued of resting the entire burden of improving the highways upon the people of the rural districts, one half, and in some cases more than three fourths, of the wealth of the country wholly escapes this burden.

When practically all the people lived in the country and very few in the city, this system of taxation was a fairly just one; nearly all the people contributed. It was the intention of the founders of the government that this should be the case. But with the concentration of wealth and population the burden has been shifted, and a large proportion of those most abundantly able to bear the cost now escape. In order to re-establish in a measure the original policy whereby all the people should bear all the cost of improving the roads, it is necessary to adopt a different plan.

The State aid plan works well in the States where it has been tried. New Jersey, Massachusetts, Connecticut, and New York have tried it, and now Pennsylvania and Delaware have come to the front with State aid laws. The plan of State aid, briefly stated, is this: The State pays a fixed part of the cost of building roads out of the general fund raised by taxation of all the people and all the property in the State. Under those circumstances corporations, railroads, trusts and the various representatives of concentrated wealth in the cities, all contribute to this fund. When the appropriation of the money is made, however, the fund is expended in the rural districts, but it must be supplemented by money raised by local taxation. In the State of New York, which I believe has the best method of all, the State pays one half, or 50 per cent, the county 35 per cent, and the township 15 per cent.

This leads to a consideration of the wisdom of extending the principle involved in State aid so as to include the United States government. As already stated, the United States began by building certain roads and paying the total cost. Later this policy was reversed and the government did nothing. Under the early policy the government did too much, and under the later policy too little. A policy should be adopted under which the government will supplement the funds raised by State and local taxation. In States which have adopted State aid, the funds raised locally are supplemented by the State funds. So, on the same principle, the funds raised by State and local taxation, should be supplemented by a fund contributed by the General Government.

It is a remarkable fact that no country in the world has ever succeeded in producing a permanent system of well improved highways without the aid of the general government of the country. To the extent that the matter has been left to the local authorities, to that extent the roads have remained unimproved or deteriorated after improvement. It is true that the English government has never taken any portion of the imperial revenues to improve the roads in the United Kingdom; but it is also true that during

the closing years of the 17th century Parliament passed many acts giving exclusive jurisdiction of the roads named to turnpike companies, with authority to collect revenue by taking toll from all the people passing over the road. Subsequent acts finally placed all the principal roads of the kingdom under the jurisdiction of these turnpike companies; and so the burden of building and maintaining the roads was shifted from the shoulders of the local community to the shoulders of the traveling public, which in those days was obliged to pass over the common roads as there were no railways. This practice continued for nearly 200 years and was only recently changed by abandoning the toll gates and placing the repair of the roads again upon the shoulders of the local communities. But this has proven to be unsatisfactory and the roads are deteriorating under the new plan, which is really a return to the old plan that had been abandoned more than 200 years ago. It seems likely that half the cost of maintaining these roads will have to be paid out of the imperial revenues of the general government.

A comparison of the cost of transportation over the common roads of the United States with the cost of transportation over the macadamized or highly improved roads in Europe shows that it costs from two to three times as much to transport the products of the country over the unimproved roads of the United States as it costs to transport similar productions and tonnage over the improved roads of Europe. About 8 cents per ton per mile is the average cost on European roads; whereas in the United States the cost is about 25 cents per ton per mile. This question has been thoroughly investigated by different State governments and by the United States government with the following results: In 1893 the Highway Commission for the State of Ohio reported that the average cost per ton per mile in that State was 25 cents. In 1896 the United States government, through the Office of Road Inquiries in the Department of Agriculture, after an extensive inquiry covering 1,200 counties in nearly all the various States of the Union, reported an average cost of 25 cents per ton per mile; and the Highway Division in the State of Maryland in 1898 reported the cost per ton per mile to be 26 cents in that State.

The macadam road is the cheapest, most durable and most suitable for the permanent improvement of country highways of anything yet devised, developed or discovered. The value of this road consists largely in its cheapness and simplicity. Before the days of John L. Macadam it was thought necessary to lay a substructure of heavy stone under the superstructure of the finished road in order to support it. Macadam contended that the substructure of heavy stone was not only useless but harmful, and that a comparatively thin layer, not to exceed 10 inches, composed of the angular fragments of broken stones reduced to a uniform size, would make a better road than a greater mass underlaid with a heavy substructure. He would allow no stone of greater weight than six ounces to go into the road. He also insisted that these angular fragments without a mixture of any other substance would consolidate under the traffic of the road so as to form a crust, smooth, hard, and impervious to water. The earth itself, he said, must not only bear the weight of traffic passing over

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it, but the weight of the road itself, and the earth, when kept dry, is abundantly able to bear this weight; but if wet the foundation will sink irrespective of the heavy stone that may be laid in it. Isaac B. Potter, writing on this matter for the Good Roads Library, says of the origin and development of the macadam road:

The macadam road was not invented in a day. It is more a development than a creation. The roads of the ancients were often made of huge blocks of stone and some of them were laid to a depth of several feet, as though the stone itself were the main thing on which they relied to support their traffic. By and by it came to be noticed that large blocks of stone when placed at the surface of the road, soon became slippery; that the edges were soon rounded off; that this surface made an insecure footing for the horses' feet and a "bumpy," unpleasant roadway for travelers who rode over it. Then smaller stones, and in some cases gravel, was used as a top layer, but the large stones were still retained in the bottom of the road. When a new road was made huge trenches were dug to the full width of the roadway and sometimes several feet deep. In the bottom of one of these trenches large, rough stone blocks were laid, one layer on another, until the trench was nearly filled. Small stones were used in the upper layers and finally the finishing layer was composed of small broken stone or gravel. Some of these roads were very good, but they were all expensive and unreasonably so. Thousands of tons of stone, millions of wealth and endless labor were wasted in work that was wholly unnecessary and useless. Macadam rejected the method of Tresaguet which included a pavement of large, rough stones set on edge and adopted a method of construction which soon proved its excellence and made him famous. It has since been largely adopted by the engineers of France and other countries and is today the method almost wholly used in making country roads in France, Switzerland, Germany and England.

Nothing has marked the advancement in road building within the last generation as much as the application of labor-saving machinery, now used in road construction. In the days of Macadam the stone was all broken by hand and the process of consolidation was effected by the daily traffic as it passed over the road while in the process of construction. At the present time we have rock crushers for the purpose of reducing the stone to angular fragments; revolving screens for the purpose of separating the stone into different sizes, and from the dust, which is used as a filler and binder over the larger fragments. The power that crushes the rocks also elevates the resulting product into high bins, from which the road surfacing material is loaded into automatic dumping carts by gravity alone, and then these automatic dumping carts or wagons when driven to the road that is under construction are emptied of their contents by gravity and the material spread upon the roadbed at a uniform width and thickness by the forward motion of the automatic dumping carts or wagons as they discharge their loads. These angular fragments are crushed by machinery and separated by the automatic process without the hand of labor being applied in the ordinary manner, and are finally consolidated into a hard, smooth and impervious crust by the passing of a steam roller over the surface many times in succession after the mass has been sufficiently moistened by the application of water, which is generally done by means of an ordinary street sprinkler. So that the finished road may now be produced in a more scientific manner than ever before, but at the same time with greater economy and much less cost, because the application of machinery has been substituted for the primitive hand of common labor.

In addition to the improvements introduced

in the crushing, handling and consolidating of the mass of stone used in the macadam roads, there are many other useful inventions in the way of earth handling machinery by which the cost of grading and shaping the road-bed is much reduced. In addition to the macadam road there are various other kinds in use in the United States, among them being the chert roads common in the South, the brick roads common in the North, and the gravel roads common in both the North and South.

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Roads and Highways. Statesmen, diplomats, historians, and scientists agree that the most important element which lies at the root and beginning of a nation's progress, and that which is indeed the greatest part of the foundation of a country's civilization, is a system of good roads. Without this the national resources and energies remain to a degree unawakened and useless. Roads are the veins and arteries by means of which the circulation of the social body is carried on. Where they are clogged the march of civilization is retarded. The people have little in common. Unity of purpose finds little place with them. Limited opportunity for intercourse of any kind hurts their commercial prospects. The natives of a country entirely without roads would of necessity be simply savages. The absence of good roads would manifestly have retarded progress in the United States had it not been for the fact that the country and the locomotive practically grew up together.

Roman Roads.—The ancient Romans were the pioneer constructors of roads, and regarded them as of vital importance for conquest and the maintenance of their empire. They are said to have learned the art from the Carthaginians. Except where some natural barrier made it impossible, the Roman roads were almost invariably in straight lines. The substantial character of these early highways is well demonstrated by the fact that they have in some instances borne the traffic of 2,000 years without material injury. The Appian Way, the "Queen of Roads," reaches its magnificent distance of 350 miles out from the gray walls of imperial Rome, under arches of imperishable fame, past massive ruins, over weird catacombs, and has won a name for all time as the royal Roman road. The Appian Way was begun by Cæsar Appius Claudius, the blind, in the year 312 B.C., and reached to Capua, afterward being extended to Brundisium. Over the "Queen of Roads" passed the Apostle Paul, and other saints and martyrs have trod the imperial way over the Campagna, and under the arch of Drusus into Rome.

British Roads.—It was the boast of Great Britain 100 years ago that, beyond all rational

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CAROLLTON AVENUE, NEW ORLEANS.

The same section of road as that shown on accompanying plate. This picture was taken April 27th, when in a day, a mile of impassable roadway had been converted into a model street.

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dispute, it stood at the head of the world's civilization, because no country on the face of the earth was so well provided with good roads. The length of pike-roads and highways in Great Britain in 1820 reached a total of 114,829 miles. These British roads were often the noblest exemplification of engineering skill, which subjugated and triumphed over great physical difficulties. Many of the British roads were carried over rivers, supported across ravines and hollows by stupendous embankments, driven underground through mountains, and sometimes terminating on piers extending far into the sea. The union of England and Scotland was due not to the kingly compact of 1707, but to the completion of a great highway between London and Edinburgh. This Great North Road, as it has been called, was later extended north from Edinburgh to the remotest extremity of Scotland—a distance greater than from London to Edinburgh. The North Road, which passes through Stamford, Doncaster, York, Durham, and Newcastle, is some 340 miles in length. Arched bridges, as a part of it, were built over the South Esk at Montrose, over the Don at Aberdeen, and over the Dean and the Tyne, the Findhorn, and the Lossie. For 37 miles the road follows the coast line entirely at Aberdeen, and thence strikes across country to Elgin, a distance of 67 miles. Notwithstanding that this section passes over much hilly country, it is so artfully conducted that hardly a single heavy grade is encountered the whole way. The good results of such a road were soon made manifest. The manufacture of coaches and private carriages was materially increased. Inns were established along the highway, the mails were carried more frequently and more quickly, the value of property was greatly increased, trade was promoted, and the general condition of even the poorest inhabitants was ameliorated by numerous accommodations and comforts which were formerly entirely beyond their reach.

The progress of civilization in India is owing largely to the military highway built by the British from Bombay to Calcutta. The English did much also for the interesting island of Jersey by building military roads across the island and around it in the year 1817. In Norway there are many important, well kept roads, and among them the great highway extending from Christiania to Leirdalsoren is conspicuously prominent. This road is 150 miles long and for the greater part of the distance winds through the mountains. The road systems of Austria, Switzerland, and some of the German states are vastly superior to anything in the United States.

Roads in France.—To-day France probably leads the world in a system of good roads. Although her area is only about four times as great as that of the State of New York, France has spent about \$600,000,000 in the construction of her common roads, and annually spends about \$18,000,000, or three per cent, of the first cost, in keeping them in repair. France has 87 departments, answering somewhat to our counties, and within these are various forms of local governments bearing some resemblance to those generally adopted in our cities and towns. The government maintains a large body of trained engineers in its special department of roads and

bridges, to which is entrusted the practical work of constructing and repairing the common roads. These comprise: first, national roads, which generally cross several departments, connecting important cities and towns; and second, department roads, which connect the chief cities and towns within the department. The less important roads are still further classified and divided, but the roads within a department are under charge of an engineer-in-chief, whose directions to his corps of subordinate superintendents and overseers must be implicitly followed. No part of the road system of France escapes attention, and every road is subdivided into sections varying in length according to its importance.

Chinese Roads.—Even in China, the great uncivilized, the public roads are in many ways admirable from their regularity, good condition, and comfort. Upon the government highways immense bridges have been built from mountain to mountain and over deep ravines. In the Alpine-like region of XeuSi there is a government road built for the most part over bridges and along the sides of mountains at an enormous outlay of labor. This road is said to have been built under the supervision of a famous general and by his army of many hundred thousand men. In building imperial highways, as in the construction of their canals, the Chinese delight in straight lines, consequently mountains are leveled or tunneled and valleys filled up to meet the road requirements. In some provinces the public highways are flanked by rows of trees on either side, or by a wall eight feet high to prevent travelers from damaging the well-cultivated fields and gardens.

American Roads.—In America, the construction of extensive public highways in this country was begun so long ago as 1776, when the first artificial road was built from Philadelphia to New York, and later the famous stage road from New York to Boston. An often proposed grand boulevard from ocean to ocean had its genesis early in the century when Ohio asked for admission to the Union. It was then a debatable question whether emigration would be drawn to Ohio, from the fact that it was cut off from the seaboard at the east—the great Alleghany Mountains forming a barrier which seemed to be impassable. The natural highways then were the waterways, the navigable streams, but it was a very long distance down the Ohio and down the Mississippi, and the journey was attended with such risks and expense that it was deemed almost impracticable. In the Senate of the United States, Henry Clay devised the means. He suggested that when Ohio was admitted into the Union there should be set aside 20 per cent,—afterward reduced to 5—of the proceeds of the sale of public lands in that State, after deducting expenses, for the purpose of building a road to connect with the Ohio River the waters that flowed into the Atlantic Ocean. Among the appropriations that were designed by Congress to help and aid that work two were vetoed, but by the indomitable perseverance of Henry Clay, which won for him the appellation, "The Father of Public Improvements," he carried his plan to a successful termination. The road which was finally built was variously known as the Great Western or National Turnpike Road, the National Highway, and the Cum-

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berland Road, and connected the District of Columbia with the Ohio River. Commenced in 1806 and built at a cost of \$1,800,000, it was the first internal improvement of any magnitude undertaken at public expense. Before the close of the year 1831 over \$200,000 had been expended upon it in repairs. The road ran from between a point nearly opposite Steubenville, Ohio, and Wheeling, in West Virginia, through Ohio and Allegheny counties to Cumberland, thence through Cumberland and Washington counties and in Frederick County to Frederickton, all in Maryland. Connecting there was a road that led to Baltimore and one that led to Washington, D. C. The national road had a uniform width of 80 feet, and was afterward extended westward from the Ohio River to Indianapolis. Other highways followed this pioneer turnpike, and prominent among these was the Old State Road from Albany to Buffalo and thence westward through Cleveland to the prairie lands of the Mississippi Valley.

The Santa Fé Trail.—The original highway across the western prairie region was the famous Santa Fé Trail extending from Saint Louis to Santa Fé, N. M., and was first established early in the century. The people of Missouri in 1825, secured a congressional appropriation of \$30,000 for the building of a better wagon road to Santa Fé. I. C. Brown made the survey, but the road was never completed. The first Santa Fé Trail was directly westward from Independence, Mo., to the mountains of Colorado, and thence south to Taos, which is about 175 miles north of Santa Fé. Afterward, as the trade grew, another trail was considerably used, the route which was followed substantially by the Atchison, Topeka and Santa Fé Railroad. But the favorite "old Santa Fé Trail" was that along the Arkansas, thence across to the Cimarron, thence almost in a direct line to Wagon Mound, N. M., a conspicuous landmark, thence to Las Vegas, San Miguel, and Santa Fé. To the northward the pony express blazed the way across the plains to the Pacific coast, followed by the stage-coach and the wagon trains, and later the Union Pacific Railway marked the path of commerce that eventually brought the Atlantic and Pacific in close relation. From those pioneer days to the present the United States have been building roadways—north, south, east, and west—only when increasing internal commerce made it necessary, and the roads thus constructed were made cheaply and with no eye to the future.

Road Building.—The fact is patent that the United States government has practically wasted hundreds of thousands of dollars in repairing and maintaining poor roads, which is in itself another argument in favor of great national highways of proper construction. Measured by every rule of economy, the common roads of the United States constitute a poor investment and are the worst in the civilized world. For nearly a century the United States has been expending more in labor and money to carry on a system of inefficient and shiftless roadways than would be sufficient to keep in proper repair double the length of high class roads under the methods pursued by France, Italy, and other countries in Europe. In this almost hopeless struggle for road reform America has but followed in the footsteps and repeated the history of European

nations, where, in the beginning, the same obstacles were encountered and the same objections urged which meet the American to-day. Road building is in itself an art apart—a type of engineering accomplishment—to which few men have given more than brief study, and none, so far as we know, have made the subject a life-work. The properly built highway is something more than the work of an engineer, for it is a boon and a blessing to mankind and to civilization. Like a great poem, it will live in after years and bring fame to the man who has built intelligently and for all time. In the laying out of a new road the skill and ingenuity of the engineer are taxed to make the gradients easy, with as little expense as possible in excavating and embanking, without deviating much from the direct course between the fixed points through which the roads must pass. In order to do this, an accurate survey of the tract, including the relative levels of its different parts, and the nature of the strata, is a necessary preliminary. The formation of an extended line of road often involves the construction of extensive bridges, viaducts, and the like, which requires the greatest engineering skill. The best method for road building is a much debated subject among engineers, and there are many systems which are worthy of consideration. The great rival systems of Telford and Macadam are perhaps the most widely known, but the many systems afford a fascinating study for one interested in the welfare of mankind.

Ocean to Ocean Boulevard.—Considering the plan for a great national highway from ocean to ocean, a grand boulevard stretching from the Atlantic to the Pacific, the scheme appears so feasible that one marvels it was not accomplished long ago. The air-line distance from New York to San Francisco is 2,600 miles, and the railroad distance 3,370 miles. The railroads, in order to reach commercial, mining, and manufacturing centres, vary greatly from their natural route. A national ocean-to-ocean highway should traverse the distance in about 3,000 miles, starting from Boston and passing through the cities of Buffalo, Cleveland, Toledo, Chicago, Omaha, and Denver to San Francisco. The suburban system of boulevards in each of these cities will average 25 miles from east to west, making a total of 200 miles of a great national roadway already constructed. A hundred smaller towns and cities with well paved roadways, averaging from 2 to 10 miles from east to west, will add 500 miles, making in all scarcely more than 2,000 miles of roadway to be built. Of this 2,000 miles, fully 1,200 miles of roadway already exist in main-traveled highways from east to west, and these inland roads would be widened and improved. This would leave but something like 800 miles of roadway to be bridged, blasted, or filled. In the event of a national highway being built across the continent, it has been suggested that convict labor be employed in the construction of the road, each State adding its quota. Heretofore, there has been great objection to this class of labor in almost every line of work, on account of the feeling that convicts employed in this way deprive free labor of its function. This is universally true except in road building, for on account of the great expense coincident with the employment of free labor, no State has un-



CAROLLTON AVENUE, NEW ORLEANS.

This street, on the outskirts of the city, was chosen for improvement. The picture was taken on the morning of April 26th, before the experiment was begun.

ROAN ANTELOPE — ROANOKE ISLAND

dertaken to build roads to an extent great enough to require a large amount of it. Convicts have been used abroad in building many important local and national works. The great docks at Liverpool, which virtually made that city famous, were constructed entirely by such labor. It is safe to say that these huge structures would never have been built had the work necessitated the employment of free labor with its accompanying cost. Time need be given little consideration in the construction of an ocean-to-ocean boulevard. In this age of rapid construction the element of time is practically annihilated. That far-famed monument of antiquity, the Great Wall of China, was completed within a space of five years, and the length of this great wall is upward of 1,500 miles. The country over which it passes is wild and hilly, and in some places it is built on the steep sides of mountains between 5,000 and 6,000 feet above the level of the sea. The wall crosses rivers and valleys, and in some places large tracts of marsh land were great obstacles to the architects, but all these difficulties were overcome. To accomplish this work the power of a despotic emperor was exerted, and every third man in the kingdom was forced to labor at the undertaking.

WILL M. CLEMENS,

Editorial Staff, 'Encyclopedia Americana.'

Roan Antelope, a large and handsome South African antelope (*Hippotragus equinus*), related to the exterminated blaubok and the beautiful sable antelope, which is of a reddish hue, with strong black and white markings on the face. It is becoming very rare.

Roanne, rô-än, France, town in the department of the Loire and an important railway junction, 59 miles by rail northwest of Lyons. Extensive engineering work shops are located here, besides iron and copper foundries, many dye-works, pottery and tile works. Pop. about 36,000.

Roanoke, Va., city in Roanoke County; located on the Roanoke River and on the Norfolk & Western railroad, 53 miles west of Lynchburg. Roanoke was formerly a leading tobacco market, but in later years has become the centre of a large section rich in iron mining and farming interests.

Industries.—Roanoke has extensive iron manufacturing interests, rolling mills, tobacco factories, bottling works, box factories, locomotive and car shops, canning factories, wheel and spoke factories, machine shops, saw mills, planing mills, wooden-ware factories, knitting and silk works, iron furnaces, bridge works, foundries, rolling mill, cotton mill, carriage and wagon factories, and many smaller industries. It had an assessed property valuation in 1903 of \$13,158,881.58. Municipal tax rate, \$1.25 on the \$100.

Public Buildings.—The Virginia College for young ladies and the National Business College for both sexes are located here, and the famous Hollins Institute for young ladies is located within seven miles of Roanoke. There is also a very fine high school, and grammar and other schools, court-house, city-hall, Academy of Music, and numerous fine business blocks.

Government.—The city is governed by a mayor and city council elected by the people. There is an excellent paid fire department and

electric street railways and electric lights. The city has an improved sewer system and two waterworks plants. There are several national and State banks, excellent hotels, daily and weekly newspapers and monthly periodicals.

Population.—Roanoke was incorporated in 1884, and has grown steadily in population and wealth. At that time the population was 5,000; in 1890 it had 16,159 inhabitants, and in 1900 this had increased to 21,495. The population in 1910 was 34,874.

E. B. JACOBS,

Secretary Roanoke Chamber of Commerce.

Roanoke, a river in Virginia and North Carolina, formed by the confluence of the Dan and Staunton rivers at Clarksville, Va. It flows south and southeast for nearly 300 miles, entering the Atlantic Ocean through Albemarle Sound. It is a tidal stream fully 80 miles from its mouth and is navigable to its source. The Dan and Staunton are navigable for small vessels for some distance from the Roanoke. At Halifax, N. C., there are rapids and falls which furnish considerable water-power. A canal has been built around this obstruction to navigation.

Roanoke College, located at Salem, Va. It was established in 1853 under the auspices of the Evangelical Lutheran Church, and is governed by a self-perpetuating board of trustees. It offers a classical course, leading to the degree of A.B., and a business course, and has also a preparatory department. It is coeducational, but few women have enrolled. The college possesses a numismatic collection of considerable value, a library with 24,000 volumes (in 1910); and grounds and buildings valued at over \$100,000. The productive funds amount to \$136,500, and the annual income in 1910 was \$29,000. The students numbered 210, and the faculty 19.

Roanoke Colony, The, in American colonial history, the name applied to a famous land grant of the crown. In 1584 Sir Walter Raleigh, having obtained a large grant of land from Queen Elizabeth, sent out 9 April, seven vessels and 108 settlers under the command of Sir Richard Grenville. After skirting the West Indies and Hispaniola, they landed at Roanoke, in North Carolina, 20 June. Ralph Lane was left in charge of the settlement and Grenville returned to England. During the following winter Lane made numerous exploring expeditions and suffered greatly from Indian attacks. In the spring he received some aid in men and supplies from Sir Francis Drake, but finally the settlers persuaded Drake to take them home. Soon after Grenville arrived with new settlers. These had been destroyed by the Indians when, in 1587, a new colony of Raleigh's, under White, came out. White himself returned to England. When he came back (1590) he found the colony vanished. It seems to have been destroyed by the savages, though there is a theory that descendants of the colonists are still to be found among North Carolina half-breeds.

Roanoke Island, Battle of. After the capture by Union troops of Forts Hatteras and Clark, at Hatteras Inlet (q.v.), 29 Aug. 1861, the Confederates began to erect works on Roanoke Island, to command the narrow channel connecting Albemarle and Pamlico sounds, considered as the key to one third of North Caro-

ROARING — ROBBER-FLY

lina, the possession of which by the Union forces would enable them to reach the railroad connecting Richmond with New Orleans. The Union authorities decided to seize the position, and 7 Jan. 1862 Gen. Burnside, who had a division of 12,000 men, was ordered to seize and hold Roanoke Island, capture Newbern and Fort Macon, open the harbor of Beaufort and, if practicable, to advance from Newbern and seize the railroad to Goldsboro. On 7 January vessels carrying the troops set sail from Annapolis, and by night of the 10th more than 80 vessels of all kinds had rendezvoused at Fort Monroe, 20 being war vessels, carrying over 60 guns, under command of Flag-Officer L. M. Goldsborough. The fleet was divided into two columns under Commanders S. F. Hazard and S. C. Rowan. The expedition sailed from Fort Monroe on the night of the 11th, and after many mishaps, in which some vessels were lost, by 4 February had passed into Pamlico Sound, and orders were given for the advance on Roanoke Island. On the morning of the 5th the start was made, with 65 vessels in all, naval vessels and transports. On the 7th the armed vessels engaged the Confederate batteries on the west side of Roanoke Island, and also small gunboats, which were soon driven off. The forts were silenced and on the morning of the 8th Burnside had over 8,000 troops and a battery ashore at Ashby's Harbor. Confronted by Confederate works, manned by nearly 6,000 men, he had formed his division into three brigades, commanded by Gens. J. G. Foster, Jesse L. Reno, and John G. Parke. The advance was ordered early in the morning, Foster leading, in the centre, Parke on the right and Reno on the left. While Foster pressed the front and engaged with his artillery, Reno, marching at times waist-deep in the mud of the swamps, gained the right of the Confederate position, Parke, in the same manner gaining the left, and, after a more than three hours' fight, a simultaneous charge was made and the entire position carried. This cleared the road. Burnside marched to the head of the island, where the forts on the shore and their entire garrisons were captured. The Union loss was 37 killed, 214 wounded, and 13 missing. The Confederate loss was 23 killed, 58 wounded, 62 missing and about 2,650 captured, including 159 officers. The Confederate gunboats went up Albemarle Sound to Elizabeth City, pursued next morning by Commander Rowan, with 14 vessels. Rowan promptly attacked, and after a short but severe engagement, Lynch, the Confederate commander, ordered the abandonment of his boats, ran them aground and set them on fire. Rowan had 2 killed and 6 wounded. Having gained entire possession of Roanoke Island and the control of the inland waters of North Carolina, Burnside's next step was the capture of Newbern (q.v.). Consult: 'Official Records,' Vol. IX.; the Century Company's 'Battles and Leaders of the Civil War,' Vol. I. See NEWBERN, OPERATIONS AT, IN THE CIVIL WAR.

E. A. CARMAN.

Roaring, a disease of horses whereby the air-passages are partially obstructed, giving rise, when the horse is briskly exercised, to a peculiar noise in breathing. The disease is due to inflammation of the larynx or of the windpipe, with wasting or paralysis of some of the laryn-

geal muscles, whereby the glottis becomes contracted. The fluid discharged from the affected parts, changing into a tough, viscid substance, adheres to the larynx and upper part of the windpipe and further obstructs them. But the specific causes of roaring are various. It sometimes follows strangles. Carriage-horses are more subject to it than saddle-horses, and this is explained by the injury done to the larynx by tight reining. There are also various kinds of roaring, distinguished by the sounds, as whistling, wheezing, high-blowing, and piping. The disorder does not appear to be amenable to treatment, though in early stages, as when it proceeds from catarrh or influenza, it may be relieved by blisters or setons. The disease renders a horse unsound, as it unfits him for the ordinary strain of work.

Roaring Forties, a sailor's term for a region of the great Southern Ocean lying south of latitude 40° to 45° S., where strong and often stormy west-northwest winds prevail. Owing to these winds the outward voyage to Australia by sailing vessels is made via the Cape of Good Hope and the homeward voyage via Cape Horn. The same name is sometimes given by analogy to a belt of the North Atlantic about 40° to 50° N.

Roasting. See COOKERY.

Rob Roy (Robert the Red), Roy, or Gael Ruidh, meaning "red"; Scottish Highland freebooter: b. Buchanan parish 1671; d. Balquhidder 28 Dec. 1734. His true name was Robert Macgregor, but he assumed that of Campbell, on account of the outlawry of the clan Macgregor by the Scottish Parliament in 1693. He was a trader in cattle previous to the rebellion of 1715, in which he joined the adherents of the Pretender. On the suppression of the rebellion the Duke of Montrose, with whom Rob Roy had previously had a quarrel, took the opportunity to deprive him of his estates; and the latter began to indemnify himself by a war of reprisals upon the property of the duke. His was a lengthy and eventful career with many hair-breadth escapes from his enemies. Consult: Sir Walter Scott's 'Introduction' to his novel of 'Rob Roy' (1818) for a full account of this chieftain, interest in whose name was aroused largely by that work; also lives by Macleay (new ed. 1881) and Miller (1883).

Robber Council. See EUTYCHES.

Robber-fly, one of the slender and long-bodied but strong and active flies of the family *Asilida*, which prey upon many kinds of insects, by darting upon them, and stabbing them with their dagger-like beaks. These instruments are armed at the tip with bristles which prevent the victim from escaping until his death is accomplished. Some species might easily pierce a man's skin, but do not do so, nor attack cattle. They are an enemy to be dreaded by bee-keepers, however, as they attack bees and where numerous may seriously interfere with their disposition to gather honey or even prevent swarming. Hence a common name is "bee-killer." Some of them resemble wasps, to whom their evil deeds are often attributed. They lay their eggs in earth-mold or rotten wood, and the larvæ live in the ground where they prey upon insects and their eggs. Over 3,000 species are known, of which about 400 are American. Consult Howard, 'The Insect Book' (New York, 1901).

ROBBER PALM — ROBERT

Robber Palm, or Cocoanut Crab, a large and powerful land-crab (*Birgus latro*) of the East Indies, related to the hermit-crabs, which lives in a hole in the earth under trees, lining its burrow with the fibrous cocoanut husks, has an almost lung-like modification of the gill-cavity for breathing air directly, yet visits the sea annually in droves to spawn. It goes abroad only at night and feeds on cocoanuts, though it does not climb for them, and is itself eaten in Amboyna and elsewhere. Darwin has graphically described how it tears the husk from the cocoanuts, and hammers on the round depressions at one end until entrance is effected. Consult Forbes, 'A Naturalist's Wanderings' (1885).

Robbery, is the wrongful taking, without a claim of right, of a thing of value from one's person against his will, or by force, or through placing him in fear. In the United States the offense is regulated by the statutes of the various jurisdictions, in some of which the degree of guilt depends on the nature of the act. Actual force need not be employed to induce fear, and fear may extend to a threatened destruction of one's property, or injury to reputation. The law does not hold that the property must be in the actual physical possession of one, or in contact with his person, but merely that it must be in his presence, or in his immediate control; the property need not belong to the person from whom it is taken. Two or more persons may be equally liable for robbery if participating in any of the acts by which it is carried out. Punishment for robbery is fixed by statute.

Robbia, rōb'bē-ā, **Luca della**, Italian sculptor: b. Florence 1400; d. 1482. In the Early Renaissance he appeared as the foremost artist of all his contemporaries, and created a new school of sculpture by his marble friezes for the organ-loft of the Duomo at Florence. These are still to be seen in the Bargello Palace of the same city. The work was completed in 1445 and represents in ten panels angels and boys, singing and playing on various instruments, to the rhythmic movement of the dance. For refined and chastened fancy, skilful grouping and animated expression this masterpiece showed a vast advance on the hieratic sculptures of mediævalism. The enthusiasm with which it was greeted was redoubled, when in conjunction with Michelozzo and Maso di Bartolommeo, he executed the bronze doors for the Old Sacristy of the Duomo (1446-64). His name is, however, especially associated with works in clay reduced to pottery in the kiln, and colored and glazed like faience. This faience sculpture was unknown before his time and in it he improved the common process of glazing by a new method all his own. Numberless were the reliefs, medallions, tympanum groups, altars and other decorations which he and his pupils produced in this style. He began by plain white reliefs on a flat blue ground; the flawless beauty of his profiles in many sculptures of this kind have been the inspiration of succeeding artists. But he gradually enriched the coloring by the addition of other tints, some critics think, with a loss to classic purity and simplicity; yet the harmonious composition of his designs, the charm of expression which appears in everything he did, added to the boldness with which he ventured into a new field of plastic art have won

for him a sort of unique glory among the artists of the Renaissance. His works and those of his pupils are met with in every part of Tuscany, and some examples may also be seen in the museums of Europe. Among his most eminent pupils were his nephew, Andrea della Robbia (1437-1528); and the sons of this latter, Giovanni (1469-1529); and Girolamo (1488-1566). Consult: Barbet de Jouy, 'Les Della Robbia' (1855); Cavalucci et Mohnier, 'Les Della Robbia' (1884); Leander Scott, 'Luca Della Robbia' (1883).

Robbin, rōb'īn, **Albert Farthing**, English writer: b. Launceston, Cornwall, 1 Aug. 1856. He entered journalism in 1871 and has long been London correspondent of the *Birmingham Post*. In addition to several comedies and other dramas he has published 'Practical Politics or the Liberalism of To-day' (1888); 'The Early Public Life of William Ewart Gladstone' (1894); etc.

Robbins, rōb'īnz, **Wilford Lash**, American Protestant Episcopal clergyman: b. Boston, Mass., 7 Aug. 1859. He was graduated from Amherst in 1881, studied at Cambridge Theological Seminary, was ordained deacon in 1884 and held his first charge at Lexington, Mass., where he was advanced to the priesthood in the following year. He was appointed dean of the Cathedral of All Saints at Albany 1887-1903 and in the year last named became dean of the General Theological Seminary. He has published: 'An Essay Toward Faith' (1900); 'A Christian's Apologetic' (1902); etc.

Robert I., king of Scotland. See BRUCE, ROBERT (3).

Robert II., king of Scotland, son of Walter III., steward of Scotland, and Marjory, daughter of Robert Bruce: b. Scotland 2 March 1316; d. Dundonald Castle, Ayrshire, 13 May 1390. He was recognized as heir to the Scottish throne by Parliament in 1318, but superseded by a son afterward born to King Robert, who succeeded him in 1329 under the title of David II. In 1333, Robert, then steward of Scotland, was a leader at Halidon Hill and in 1334 was appointed joint regent with Moray. In 1338-41 he was sole regent and after the battle of Neville's Cross in 1346, where King David was taken prisoner, was again made regent. After the death of David in 1371 Robert was declared king and was crowned shortly afterward, the first of the Stuart dynasty. He ratified a treaty with France in the first year of his reign, and continued a nominal truce with England until the succession of the English king, Richard II., with whom he waged two wars. In the latter of these Richard II. and the Duke of Lancaster made successful forays into Scotland. In 1388 these were avenged by an invasion of England by two armies and the famous battle of Otterburn (Chevy Chase) was then fought. The long continued border wars and the disorders caused by the turbulent barons caused the king, whose increasing age disinclined him to the arduous duties of reigning, to entrust the management of the kingdom to his second son, the Duke of Albany, in 1389, and he then retired from public life.

Robert III., king of Scotland, eldest son of Robert II.: b. Scotland, about 1340; d. Rothesay, Bute, 4 April 1406. He was originally known as John Stuart, Earl of Carrick, but assumed

ROBERT — ROBERT OF MOLESME

the name of Robert on his coronation in 1390. He possessed little strength of mind and incapacitated for military service by his lameness, delegated, therefore, the guidance of military affairs to his brother, the Duke of Albany. The friends of the king's eldest son, the Duke of Rothesay, forced the abdication of Albany in 1398 and war was renewed with England. Scotland was invaded for the last time by an English king in 1400, and in 1402 the Scottish troops met with disastrous defeat at Homildon Hill. Albany then regained the regency, imprisoned Rothesay at Falkland Castle, where he starved him to death, and caused Robert III., in his terror of him to send his second son James to France for safety. James was captured and imprisoned by the English and his father on learning of the event went into melancholy and died soon after. Scott's 'Fair Maid of Perth' is based upon various incidents related above.

Robert, Duke of Normandy, surnamed **THE DEVIL**: d. Nicæa, Asia Minor, 22 July 1035. He was the younger son of Duke Richard II. and ascended the throne in 1028 in succession to his brother, Richard III., whom he was said to have poisoned. The earlier years of his reign were passed in the subjugation of his vassals. Then he interfered in various princely quarrels, restoring Baldwin IV. of Flanders to his estates, and aiding Henry I. of France against the plots of the latter's mother. In 1034 he undertook an expedition against England, in support of his nephews, whom Canute had excluded from the succession, but his fleet was wrecked off Jersey, and the attempt failed. He now set out on a pilgrimage to Jerusalem; and while returning died suddenly in Nicæa, poisoned, perhaps, by his servants. His heroic deeds and penance have given rise to numerous stories. 'La Vie du terrible Robert le Diable, lequel fut après l'Homme de Dieu' appeared in 1496, and was much imitated. On it was based the grand opera, 'Robert le Diable,' text by Scribe and Delavigne, music by Meyerbeer. William the Conqueror was his son. Consult: Tardel, 'Die Sage von Richard dem Teufel' (1900).

Robert, Henry Martyn, American military engineer: b. Robertsville, S. C., 2 May 1837. He was graduated from West Point in 1857, was assistant professor of philosophy, and later of military engineering there in 1857-8 and served on frontier duty 1858-61. He was on the staff of General McClellan and on duty as an engineer through the Civil War, was promoted captain in 1863 and served as professor of military engineering at West Point in 1865-7. In 1867-95 he was on duty in connection with river and harbor improvements, lighthouses and fortifications. He was made president of the board of engineers for fortifications in 1895, was promoted brigadier-general chief of engineers in 1901 and was retired shortly after. He has published 'Robert's Rules of Order' (1876).

Robert, Louis Leopold, French painter: b. Les Eplatures, near Chaux-de-Fonds, Switzerland; d. Venice 20 March 1835. His teachers were the copperplate engraver Girardet in Paris, and the painter David. In 1818 he visited Rome and the study of life among the common people there furnished material for some of his smaller genre pictures. He was especially happy in his representation of robber life in Italy, and his

'Sleeping Brigand' in the National Gallery at Berlin is much admired. But it was at Naples that he found material for his first masterpiece 'The Improvisator' (1823). This was succeeded by 'The Return from the Festival of the Madonna' (1827), now in the Louvre; 'The Arrival of the Reapers in the Pontine Marshes' (1830) in the Louvre; of which latter a replica with variations is in the Berlin National Gallery. In 1832 he visited Venice and completed 'The Departure of the Fishermen of the Adriatic.' An unrequited attachment for the Princess Charlotte Bonaparte preyed upon his mind and he committed suicide in Venice. In his pictures the life of the Italian common people is delicately idealized, and among his contemporaries his works were greeted as they appeared with the greatest enthusiasm.

Robert of Gloucester, English historian. He was a monk in the abbey of Gloucester in the latter half of the 13th century, but of his life there nothing is known. His history of England extends from the fabulous Brutus to about 1300 A.D. The work is written in Anglo-Saxon, showing the transition stage of the language previous to Chaucer, and its chief value is linguistic. It is in verse, and contains upward of 10,000 lines and is filled with the most absurd fables. Numerous manuscripts prove its popularity. These are found in the Bodleian, Cottonian, Heralds' College, and other libraries. Thomas Hearne printed it at Oxford in 1724, but the best edition is that of Aldis Wright in the Rolls series (two vols. 1887). It is partly based on earlier works, is wholly destitute of originality and some have thought it a translation from the French.

Robert of Molesme, mô-lâm, Saint, founder of the Cistercians: b. Champagne 1018; d. Molesme 1110. At 15 he became a Benedictine monk in the abbey of Montier-la-Celle, where on account of his high and religious character he was elected prior while still the youngest member of the community. He was afterward appointed abbot of Saint Michael de Tonnerre. He was induced to leave this abbey through the recalcitrancy of the monks. In Colan, however, a desert place near the abbey, there lived certain anchorites, and at their request he became their superior; they thence removed to the forest of Molesme, where they built themselves cells and an oratory dedicated to the Holy Trinity (1075). Here the community became relaxed in discipline through the bounteous contributions provided by the bishop of Troyes and others. Robert therefore left them and eventually settled with some devout members of the abandoned community at a place called Cistercium, or Cîteaux, five leagues from Dijon in the diocese of Chalons. They chose a spot in the uninhabited forest with the consent of Walter, bishop of Chalons, and Renand, viscount of Beaune, lords of the territory. The day of their establishment was Saint Bennet's Day, 21 March 1098, from which must be dated the foundation of the Cistercian Order. The rule established by Saint Robert allotted four hours for sleep, four for singing the offices, four for manual labor and four for study. Thus was the great, practical, and highly useful Cistercian Order founded; and it was presided over by Abbot Robert until his death.

ROBERT COLLEGE — ROBERTS

Robert College, Constantinople, Turkey, so called after Christopher R. Robert of New York, its chief benefactor, was organized by James H. and William B. Dwight, sons of the Rev. Harrison G. O. Dwight, an American missionary to Turkey. It was opened in 1863, its financial support being guaranteed by the philanthropy of Mr. Robert who died in 1878, and whose total contributions to the institution amounted to \$450,000. In 1864 the college was affiliated to the University of New York. Its first president was the Rev. Cyrus Hamlin, D.D., who at his resignation in 1877 was succeeded by the Rev. George Washburn, D.D. The curriculum is similar to that of the average American college; while English is the principal language in use, instruction is also given in 13 other languages. The first home of the college was in a private house; the two college buildings built in 1871 and 1891 respectively occupy a fine site on the Bosphorus.

Robert Elsmere, a novel by Mrs. Humphry Ward, published in 1885. It is a brilliant example of the embodiment in a work of fiction of intellectual problems of contemporary interest and recounts the struggles of an Anglican clergyman who cannot accept all the miracles and dogmas of Christianity, while in deep sympathy with its spirit. The work had a phenomenal success, partly owing to the nature of its subject, and partly to its genuine literary merit. Aside from its intrinsic value, the sensation it produced entitles it to rank as one of the most remarkable books of its generation.

Robert-Fleury, rô-bâr flê-rî, **Joseph Nicolas**, French painter: b. Cologne 8 Aug. 1797; d. Paris 5 May 1890. In early life he studied under Gros at Paris, and after visiting the galleries and studios of Italy finally settled in the French capital. His works are distinguished for impressive characterization and profound sentiment; and among them may be mentioned: 'Night of Saint Bartholomew's' (1833); 'Religious Conference at Poissy in 1561' (1840); 'Jane Shore after her Condemnation Insulted by the People' (1850); 'Sack of a Jew's House at Venice in the Middle Ages' (1855); the last three are in the Luxembourg Museum. He also decorated with paintings the hall of the Chamber of Commerce at Paris.

Robert-Fleury, Tony, French painter: b. Paris 1 Sept. 1837. He was a pupil of Delaroche and Cogniet and is known for his historical and genre pictures, as well as for portraits. Among his best works are: 'Warsaw on 6 April 1861'; 'Scene During the Polish Insurrection'; 'The Old Women of the Piazzo Ravona, Rome' (1867, in the Luxembourg); 'The Daughters of Danaus' (1873); 'Charlotte Corday at Caen in 1793' (1874); 'The Sack of Corinth' (1870, in the Luxembourg); and a ceiling picture in the Luxembourg 'The Apotheosis of French Sculpture.'

Roberton, E. H., English mining engineer: b. West Riding, Yorkshire, 1877. He was graduated from Christ Church, Oxford, in 1899, studied engineering at Rutherford College, Newcastle-on-Tyne, and in 1892 became demonstrator of mining at the University of Birmingham. He has also assisted in the studies and investigations connected with the Royal Coal Commission.

Roberts, Benjamin Stone, American soldier: b. Manchester, Vt., 1811; d. Washington, D. C., 29 Jan. 1875. He was graduated from West Point in 1835, and in 1839 became chief engineer in the construction of the Champlain and Ogdensburg railroad. He was assistant geologist of New York State in 1841, and in 1843 was admitted to the bar and engaged in law practice. At the outbreak of the Mexican War he re-entered the army with rank as lieutenant. He served at Vera Cruz, Cerro Gordo, Contreras, Churubusco, Matamoras and the Galajara pass, was promoted captain, received brevet rank of lieutenant-colonel, and at the close of the war was voted a sword of honor by the Iowa legislature. In 1861 he was commissioned brigadier-general of volunteers and served under General Pope as chief of cavalry in the Army of Virginia. He was present at Cedar Mountain and the second battle of Bull Run and at the close of the war was brevetted brigadier-general in the regular army. In 1866 he became lieutenant-colonel of cavalry and in 1868 accepted the chair of military science at Yale which he occupied until his retirement in 1870. He was the inventor of the Roberts breech-loading rifle.

Roberts, Benjamin Titus, American Methodist clergyman: b. Leon, Cattaraugus County, N. Y., 1823; d. Chili, N. Y., 27 Feb. 1893. He was graduated at Wesleyan University in 1848, joined the Genesee Conference of the Methodist Episcopal Church, but in 1860 was one of the seceders from that body who founded the Free Methodist sect, of which he became the first general superintendent. In the same year he began a monthly magazine called 'The Earnest Christian' and in 1865 founded the Cheesborough Academy at North Chili, N. Y., serving as its president from 1869 until his death. He wrote: 'Fishers of Men'; 'Why Another Sect'; 'First Lesson in Money'; 'Ordaining Women.'

Roberts, Brigham Henry, American journalist and politician: b. Warrington, Lancashire, England, 13 March 1857. In the summer of 1866 he emigrated with his parents to Davis County, Utah. In 1878 he was graduated from the University of Utah, and soon afterward was called by the Mormon Church to its missionary service. After laboring for some years as a missionary he was elected to a high office in the church. He also engaged in journalism and was editor-in-chief of the Salt Lake *Herald*. In 1895 he was a member of the State Constitutional Convention. At the first State election he was the Democratic nominee for Representative to Congress, but was defeated. In 1898, however, he was elected by a large majority. His election created widespread agitation throughout the country, and on 25 Jan. 1900 the House of Representatives by an overwhelming majority voted to exclude him as constitutionally ineligible, as a polygamist, to a seat in that body. He is the author of 'The Gospel' (1888); 'Life of John Taylor' (1892); 'Outlines of Ecclesiastical History' (1893); 'Succession in the Presidency of the Church' (1893); 'A New Witness for God' (1895); 'Missouri Persecutions' (1900); 'The Rise and Fall of Nauvoo' (1900).

Roberts, Charles George Douglas, Canadian author: b. Douglas, near Fredericton, New

ROBERTS

Brunswick, 10 Jan. 1860. He was educated at the University of New Brunswick, in 1883-4 was editor of the *Toronto 'Week'*; in 1885-7 was professor of English and French literature in King's College (Windsor, N. S.); and was professor of economics and international law from 1887 until his resignation in 1895, since when he has lived in New York. His reputation was first made as a poet with a gift of melody, a clear and grave manner, and a particular felicity, noticeable in the Canadian school, in pictures of nature. Later, he became equally known for his prose work in 'The Heart of the Ancient Wood' (1900), and 'The Kindred of the Wild' (1902), the latter one of the most successful of imaginative treatments of wilderness life. The collection of short stories, 'Earth's Enigmas' (1896), also is marked by an interesting individual quality. Among Roberts' other volumes are: 'In Divers Tones' (1887); 'Ave: An Ode for the Shelley Centenary' (1892); 'Songs of the Common Day' (1893); 'The Raid from Beau-sejour' (1894); 'A History of Canada' (1897); 'The Book of the Native' (1897); 'The Forge in the Forest' (1897); 'By the Marshes of Minas' (1900); 'The Book of the Rose' (1903).

Roberts, David, English painter: b. Edinburgh 24 Oct. 1796; d. London 25 Nov. 1864. In 1818 from being a house painter he advanced to the profession of scene painter, and in 1821 painted scenery for the stage of Drury Lane, London. All this while he was studying drawing and oil painting, and in 1826 and 1827 he attracted attention by his pictures of Rouen and Amiens cathedrals. Later on he traveled in Spain, Morocco, Egypt, Palestine, Italy, Belgium, making drawings of great buildings and landscapes with picturesque edifices, and working them up into pictures. Among his works the following are the most noteworthy: the drawings from Spain for the 'Landscape Annual' (1835-8); and illustrations for the volume entitled 'The Holy Land, Syria, Idumea, Arabia, Egypt, and Nubia' (1842). His other pictures represent numerous interiors of churches; as St. Miguel at Xeres, Holy Nativity at Bethlehem, St. Jean at Caen, St. Paul at Antwerp, St. Peter's at Rome, the cathedrals of Milan and Seville. Among his religious historic pictures are 'Departure of the Israelites from Egypt' (1829); 'Ruins of the Great Temple at Karnac' (1845); 'Destruction of Jerusalem' (1849), which were followed by 'Rome' (1855); and 'Grand Canal at Venice' (1856). Roberts' style was essentially spectacular; he produced grand, broad effects, with magnificent architectural arrangements, to which the details are of course generally sacrificed.

Roberts, Ellis Henry, American financier: b. Utica, N. Y., 30 Sept. 1827. He was graduated from Yale in 1850 and in the following year became editor and proprietor of the *Utica Morning Herald*. He sat in the State legislature in 1867, was a member of Congress 1871-5, afterward continuing his editorial work until 1889, when he was appointed assistant treasurer of the United States. In 1893-7 he was president of the Franklin National Bank in New York, and since 1897 has been United States treasurer. He has published: 'Government Revenues' (1884); 'The Planting and Growth of the Empire State' (1887).

Roberts, Sir Frederick Sleigh Roberts, 1st EARL, English military officer, son of General Sir Abraham Roberts: b. Cawnpore, India, 30 Sept. 1830. He was taken to England at two and was educated at Clifton, Eton, the Royal Military College at Sandhurst, and at the East India Company's cadet college at Addiscombe. In December 1851 he was appointed 2d lieutenant in the Bengal artillery and in the following April sailed to join his company at Dum-Dum. A few months subsequently he became aide-de-camp to his father, then in command of the Peshawur division, and in November 1854 was posted to a troop of horse artillery on the north-western frontier. His ability secured for him a staff appointment as deputy assistant quartermaster-general and when the Punjab movable column was formed to quell the mutiny, young Roberts was chosen by Neville Chamberlain as his staff-officer, a position he likewise held under Chamberlain's successor, Nicholson. His first experience of actual warfare was at the siege of Delhi, where he was wounded, and in June 1857 he was promoted lieutenant. In September he left Delhi in command of a force bound for Cawnpore, and in the subsequent operations for the relief of Lucknow took an active share. At Khundaganj he rescued at the risk of his life a comrade hard pressed by the enemy, and then captured a standard guarded by two sepoys, for which services he was awarded the Victoria Cross. He participated in the re-establishment of English authority at Fategharh and at Lucknow, and in 1858-60 was on leave of absence to England. He returned to India in the latter year with rank as captain and brevet major, and served again under Sir Neville Chamberlain in the Umbeyla campaign of 1863. In the Abyssinian campaign in 1868 he served as assistant quartermaster-general, held a command in the Lushai expedition of 1871-2 and in 1872-5 was deputy quartermaster-general. He was promoted major-general in 1878 and on the outbreak of the Afghan war was assigned to command the Kuram field force. On 21 November he advanced into Afghanistan though without communication with India and wholly dependent upon a hostile country for supplies. Nine days later he forced the Afghan position at Peiwar Kotul, but further operations were suspended by the treaty of Gandamak. The murder of the British ambassador, Sir Louis Cavagnari, at Kabul, resulted in renewal of the war in 1879, and in October General Roberts again moved against the Afghans. He utterly defeated the forces of Yákub Khan at Kabul, forced his abdication, sent him a prisoner to India, and then occupied with the British forces the fortified cantonment of Sherpur. In 1880 intelligence of the siege of the British garrison at Kandahar by Ayub Khan reached General Roberts and on 9 August he set out to the relief of the garrison with an army of 10,000 picked men. For three weeks the army was lost from the view of the world, but on 31 August Roberts reached Kandahar, gave battle to Ayub Khan, routed his army, and captured his artillery and camp. After the withdrawal of troops was effected he visited England, where he was enthusiastically welcomed and showered with honors. He was created a baronet, presented with the freedom of cities, received the thanks of Parliament and a special

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medal was struck in honor of his march to Kandahar. In 1881 he was ordered to South Africa as governor of Natal and commander-in-chief against the Transvaal Boers, but peace was concluded before his arrival. He returned to India in November 1881, with rank as lieutenant-general in command of the Madras army, and in 1885 became commander-in-chief of India. In 1890 he received full rank as general and in 1892 was created a baron. He resigned his command in 1893 and returned to England, where he was appointed commander-in-chief of the forces in Ireland in 1895, sworn as a member of the privy council of Ireland, and later in the same year made field-marshal. After the disasters which had continuously beset the British arms in South Africa in 1899 at Stormberg, Magersfontein and Colenso, where Roberts' only son fell, the public turned their attention once more to the field-marshal and clamored for his appointment as commander. He arrived at Cape Town early in 1900 with Lord Kitchener as his chief of staff and at once proceeded to the relief of Kimberley. He captured General Cronje with a large share of his force at Paardeburg, then continued a steady fight until Ladysmith was relieved, and a forced march to Bloemfontein followed by the occupation of that post with British troops. Three months later came the second critical point in General Roberts' manipulation of the war. He made a rapid advance upon Johannesburg and Pretoria by way of Kroonstad and Vereeniging and though handicapped by short rations, opposed at almost every step of the way by the enemy, and with railway communication cut off, Roberts moved steadily upon the Boer capital, seized it, relieved Mafeking, annexed the two republics by proclamation, and in the latter part of 1900 declared the war ended. He then resigned his command and returned home. Parliament voted him its thanks and a gift of £100,000, he was advanced to the peerage as Earl Roberts of Kandahar, Pretoria, and Waterford, and Viscount Saint Pierre, and made commander-in-chief of the United Kingdom. In 1901 he became a member of the privy council. His only son having been killed at Colenso, the peerage will by special grant descend to his daughter. Lord Roberts is to the British army the ideal of a soldier, and by the rank and file is affectionately termed "Bobs." Added to his military skill is an inexhaustible capacity for detail, a quick grasp of possible alternatives, a tireless energy, and the power to command men and to infuse them with his own indomitable courage and determination. He has written: 'The Rise of Napoleon' (1895); and 'Forty-one Years in India' (1897).

HARRIET BRUNKHURST,
Editorial Staff, 'Encyclopedia Americana.'

Roberts, Howard, American sculptor: b. Philadelphia 1843; d. Paris 19 April 1900. He studied at the Pennsylvania Academy of Fine Arts, and in 1866 went to Paris and studied under Dumont and Gumery at the Ecole des Beaux Arts. In 1875 he established a studio in Philadelphia and at the Centennial Exhibition exhibited a statue, 'La Première Pose,' that created a sensation on account of its superior technical qualities. He received one of the three medals awarded to American sculptors.

Other works are 'Eleanor'; 'Hester Prynne'; 'Hypatia'; 'Lot's Wife,' nearly all being at the Pennsylvania Academy.

Roberts, John Bingham, American surgeon: b. 29 Feb. 1852. He was graduated at the University of Pennsylvania in 1871, and at the Jefferson Medical College in 1874. He is president of the Philadelphia County Medical Society, Medical Society of the State of Pennsylvania, and vice-president of the American Surgical Society. He is a contributor to medical and scientific papers and has published 'Paracentesis of Pericardium' (1880); 'Surgery of Human Brain' (1885); 'Fractures of Radius' (1897); 'Deformities of the Face' (1900); etc.

Roberts, Margaret, British novelist: b. Honyngs, North Wales, 1833. She has lived much on the Continent and wrote her first book in Italian. Her books, which have been published, for the most part, anonymously, include 'Atelier d'Lys'; 'Mademoiselle Mori' (1860); 'Denise' (1863); 'Madame Fontenoy' (1864); 'On the Edge of the Storm' (1868); 'In the Olden Time' (1883); 'Under a Cloud' (1888); etc.; several of these have been much read in this country.

Roberts, Morley, English novelist and journalist: b. London 29 Dec. 1857. After study at Owens College, Manchester, he went, in 1874, to Australia, and there worked on railways in Victoria and as a sheep and cattle rancher in the New South Wales bush. Then he was before the mast in merchant ships, and after some experience in the quartermaster general's department of the British war office and in the India office, set out again traveling, visiting in 1884-6 many of the western United States, Canada, British Columbia, and Manitoba, and later the South Seas. His hardships and adventures have lent a certain element of vigor to his stories, which are better known in England than in the United States, and include: 'King Billy of Ballarat' (1891); 'The Reputation of George Saxon' (1892); 'Red Earth' (1894); 'The Degradation of Geoffrey Alwith' (1895); 'The Great Jester' (1896); 'The Circassian' (1899); with Max Montesole, an interesting book of Eastern life; 'The Keeper of the Waters' (1898); 'The Colossus' (1899), which, as giving a portrait of Cecil Rhodes (q.v.), was perhaps most talked of among Roberts' works; 'Immortal Youth' (1902); 'The Way of a Man' (1902), etc.

Roberts, Robert Richford, American Methodist bishop: b. Frederick County, Md., 2 Aug. 1778; d. Lawrence County, Ind., 26 March 1843. He removed with his family in 1785 to Ligonier Valley, Western Pennsylvania, and was brought up on the frontier. He obtained Methodist books, studied for the ministry, in 1802 was licensed to preach, served as an itinerant preacher for several years, and later was in charge of important pastorates in Baltimore and other cities. In 1816 he was elected bishop and soon after removed to Indiana. He did much for Indian missions and among the Indians he was known as "the grandfather of all the missionaries." Consult: Charles Eliot, 'Life of Bishop Roberts' (1853).

Roberts, William Charles, American Presbyterian clergyman: b. Aberystwyth, Wales, 23 Sept. 1832. He was graduated from Princeton

University in 1855 and from Princeton Theological Seminary in 1858. He was pastor of the First Presbyterian Church, Wilmington, Del., 1858-62, the First Presbyterian Church, Columbus, Ohio, 1862-4, and the Second Presbyterian and Westminster churches, Elizabeth, N. J., 1864-82. He was president of Lake Forest, Ill., University, 1886-92, and was moderator of the General Assembly of the Presbyterian Church 1889. He has published 'The Great Preachers of Wales' (1865); translation of 'Shorter Catechism into Welsh' (1867); 'New Testament Conversions' (1895).

Roberts, William Milnor, American civil engineer; b. Philadelphia 12 Feb. 1810; d. Brazil, South America, 14 July 1881. As early as 1831 he was senior principal assistant engineer on the Allegheny Portage railroad, and in 1835 he planned and built across the Susquehanna River at Harrisburg the first combined railroad and highway bridge in this country. During the next 20 years he was engineer or contractor on many American railroads and canals. In 1857 he went to Brazil and undertook the construction of the Dom Pedro II. railroad. During 1866-8 he was U. S. civil engineer in charge of improvements of the Ohio River; from 1868-70 associate contractor with James B. Eads in building the bridge across the Missouri at Saint Louis. In 1870 he became chief engineer of the Northern Pacific railroad, and in 1874 visited Europe on an observation tour of jetties as member of the commission of civil and military engineers to report on plans for the improvement of the mouth of the Mississippi River. In 1879 the emperor of Brazil appointed him on a commission of hydraulic engineers to report on harbors and rivers of Brazil, and in prosecution of these labors he died of a fever. He was president of the American Society of Civil Engineers in 1879.

Roberts-Austen, William Chandler, English metallurgist; b. 1843; d. 22 Nov. 1902. He was graduated at the Royal School of Mines, London, and became an assistant in the mint. In 1869 he was made assayer to the mint, and in 1882 was appointed queen's assay master. He had already, in 1880, been appointed professor of metallurgy at the Royal School of Mines, and held the two positions at the time of his death. He assumed the name of Austen in 1885. He was one of the founders of the Physical Society of London, of which he became vice-president; a member of the British executive council of the Paris Exposition of 1889; vice-president of the International Mining and Metallurgical Congress at Paris. He contributed papers mainly relating to metals to the 'Philosophical Transactions.'

Robertson, rōb'ert-sōn, Frederick William, English clergyman; b. London 3 Feb. 1816; d. Brighton 15 Aug. 1853. He was ordained in 1840; was graduated from Brasenose College, Oxford, in 1841; in that year he was made curate of Christ Church, Cheltenham; and from 1847 until his death was pastor of Trinity Chapel, Brighton. His eloquence was remarkable, and soon extended his renown far beyond local limits. He was an eclectic in theology, and declared for no party in a time when the clergy were generally partisans. His frequent dissent from various positions of the schools of thought, brought upon him numerous attacks, whose importance he was wont to overestimate. His views were colored by study of the Germans, and developed

considerably during the progress of his ministry. His mind was positive, original, and without fear; and his constant labor greatly affected his health. He was deeply interested in the workingmen's institute, which he founded at Brighton, and whose work he made very effective. His 'Sermons' (1855-90), though derived from inadequate shorthand notes or from recollections prepared by himself, have been very widely read. His other important work has been collected in his 'Literary Remains.' Consult the 'Life and Letters' by S. A. Brooke (1865).

Robertson, Harrison, American journalist and author. He is associate editor of the Louisville *Courier-Journal*, Kentucky, and has written: 'How the Derby Was Won' (1889); 'If I Were a Man' (1899); 'Red Blood and Blue' (1900); 'The Opponents' (1902); etc.

Robertson, James, English royal governor of New York; b. Fifeshire, Scotland, about 1720; d. London, England, 4 March 1788. He entered the army and after various services sailed for America in 1756, was appointed major-general of the royal troops raised in America and barrack-master at New York. He commanded a brigade at the battle of Long Island in 1776 and after André's capture made an earnest effort to secure his release. In 1779 he was appointed royal governor of New York, and in 1782 received rank as lieutenant-general. He returned to England in the following year. His reputation was that of an avaricious and supercilious officer and in his position as governor he was charged with arbitrary measures.

Robertson, James, American pioneer; b. Brunswick County, Va., 28 June 1742; d. Chickasaw region, Tenn., 1 Sept. 1814. In 1769 he accompanied Daniel Boone (q.v.) on the latter's third exploration, and stopping at Watauga (now Elizabethton, Tenn.), planted corn. In 1770 he returned thither with a band of North Carolinian settlers. The settlement soon numbered some 200. Both North Carolina and Virginia asserted jurisdiction over it, but neither colony offered protection; and it was left an independent outpost of civilization. With John Sevier, Robertson became the head of the communities which gathered about the Holston and Watauga. In 1777 he was commissioned agent of North Carolina among the Cherokees, and during his residence of more than a year thwarted the British agent and kept at peace the great body of Cherokees and Creeks. With a party of settlers he set out in 1779 for the French Lick of the Cumberland, and on 25 December made the beginnings of a town on the site of Nashville, then 15 days' journey from the westernmost white confines. A fort built, a military organization was made, with Robertson as colonel. Troubles increased. Provisions were low, and the Indians hostile. He detached the Chickasaws and Choc-taws from their English alliance and concluded a treaty with the Cherokees. He also defended the settlement against the Creeks, who were abetted by the Spanish authorities of Louisiana; and refused to organize a separate state in alliance with Spain. In 1790 Robertson was commissioned United States brigadier-general, and latterly he was government Indian agent. He was well fitted for his frontier career, and especially successful in his dealings with the savages. His favorite saying, "Man proposes, but God dis-

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poses," he always insisted was somewhere in the Book of Job. Consult the 'Life' by Putnam (1859); Gilmore, 'The Rear Guard of the Revolution' (1886); and 'Harper's Magazine,' February 1888, pp. 420-6.

Robertson, James Burton, English historian: b. London 15 Nov. 1800; d. Dublin 14 Feb. 1877. He was educated at the Roman Catholic College of St. Edmund, near Ware, and was called to the bar in 1825. Later he studied literature, philosophy, and dogmatic theology in France. His first important publication was a translation of Frederick Schlegel's 'Philosophy of History' (1835). He lived in Germany in 1851-4, and here produced a translation of Möhler's 'Symbolism or Exposition of Doctrinal Differences Between Catholics and Protestants' (1843), a work which made a deep impression on the Tractarians. In 1855 J. H. Newman, then rector of the Catholic University at Dublin, called him to the chair of geography and modern history and later the department of English literature was assigned him. His original works comprise lectures 'On Subjects of Ancient and Modern History' (1859); 'On Subjects of Modern History and Biography' (1864); on the 'Writings of Chateaubriand, and on the Illuminati, Jacobins, and Socialists'; 'On the Life, Writings and Times of Edmund Burke' (1869), together with poetry and translations.

Robertson, James Craigie, Scottish clergyman: b. Aberdeen, Scotland, 1813; d. Canterbury, England, 9 July 1882. He was graduated from Cambridge in 1834, and took orders in the Anglican Church, in 1836. He was made canon of Canterbury in 1859, and from 1867-74 was professor of ecclesiastical history at King's College, London. He published: 'How Shall We Conform to the Liturgy' (1843); 'Church History' (1852-73); 'Plain Lectures on the Growth of Papal Power' (1876); edited Heylyn's 'History of the Reformation' (1849); 'Materials for the History of Archbishop Thomas Becket' (1875-82); etc.

Robertson, James Logie, Scottish educator and author: b. Milnathort, Kinross-shire, 18 Sept. 1846. He was educated at Edinburgh University, and has been first English master at Edinburgh Ladies' College from 1891. He has published several volumes of pleasing verse, 'Horace in Homespun' (1886); 'Ochil Idylls' (1896); 'Adaptations from Dunbar' (1895); etc., while among his prose works may be cited 'In Scottish Fields' (1890); 'A History of English Literature' (1894). He has also edited editions of Scott (1894) and Burns (1896); 'The Select Chaucer' (1902); etc.

Robertson, Morgan, American author: b. Oswego, N. Y., 30 Sept. 1861. He was educated in the public schools and at Cooper Institute; went to sea in 1877-86 and then engaged in business as a jeweler. He has published: 'A Tale of a Halo' (1894); 'Spun Yarn' (1898); 'Where Angels Fear to Tread' (1899); 'Shipmates' (1901); 'Down to Sea' (1903); 'Down to the Sea' (1905).

Robertson, Thomas William, English actor and dramatist: b. Newark on Trent, 9 Jan. 1829; d. London 3 Feb. 1871. He came of a theatrical family and played his first part at the age of four. He had a varied career as actor, newspaper writer, adapter of plays, as well as dramatist, in none more than successful enough

to gain a bare subsistence until he wrote 'David Garrick,' produced by E. A. Sothorn in 1864. This piece has taken a permanent place on the English stage. Following this a play called 'Society' had a long and successful run, making the fortunes of the Prince of Wales Theatre and the author. At the same house were produced his most successful series of plays, including 'Ours,' 'Caste,' 'Play,' 'School,' and 'M. P.' Some of these, especially 'Caste,' his masterpiece, are revived from time to time. His comedy was artificial, with a strong sentimental interest; but he was a good observer of manners and drew his characters from the life. He established a distinct school, and has had several followers, though in the best exponents of the later English dramas he has been replaced by writers whose methods are less artificial and hence more logical. His 'Principal Dramatic Works' were published with a memoir by his son in 1889. Consult also Pemberton, 'Life and Writings of T. W. Robertson' (1893); Cook, 'Nights at the Play' (1883); Clement Scott, 'The Drama of Yesterday and To-day' (1899).

Robertson, William, Scottish historian: b. Borthwick, Midlothian, 19 Sept. 1721; d. near Edinburgh 11 June 1793. After the completion of his course in Edinburgh University, Robertson obtained a license to preach in 1741, and in 1743 was presented to the living of Gladsmuir, in East Lothian. His 'History of Scotland During the Reigns of Queen Mary and King James VI.' appeared in 1759, and was received with general applause, though modern research has deprived it of most of its historical value. This work, which reached a 14th edition before the author's death, led to his nomination to the chaplaincy of Stirling Castle in 1759, as one of the king's chaplains in 1761, and as principal of the University of Edinburgh in 1762. The year after he was made historiographer-royal of Scotland, with a salary of £200 per annum. His 'History of the Reign of Charles V.' appeared in 1769, and his 'History of America' in 1777. His latest work appeared in 1791, under the title of a 'Historical Disquisition Concerning the Knowledge which the Ancients Had of India, and the Progress of Trade with that Country Prior to the Discovery of the Cape of Good Hope.' Consult: 'An Account of the Life and Writings of William Robertson' (1801-2); Gleig, 'Life and Writings of William Robertson' (1812); Graham, 'Scottish Men of Letters in the 18th Century' (1901).

Robeson, rōb'son, George Maxwell, American politician: b. Oxford, Warren County, N. J., 1829; d. Trenton, N. J., 27 Sept. 1897. He was graduated at Princeton University in 1847, and three years later was admitted to the bar. In 1867 he was appointed attorney-general of New Jersey, and during the two administrations of President Grant (1869-77) was secretary of the navy. He was a successful candidate for Congress in 1878 and 1880, and on retiring from Congress in 1883 resumed his law practice in Trenton, N. J.

Robeson, Henry Bellows, American naval officer: b. New Haven, Conn., 5 Aug. 1842. He was graduated from the United States Naval Academy in 1860, entered the navy as midshipman, and in 1862 was promoted lieutenant. He was engaged in the attack on Charleston, S. C., 7 April 1863, and later in the same year led a

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party from the New Ironsides in the capture of the Confederate works at Morris Island. He participated in both attacks on Fort Fisher, was advanced to be lieutenant-commander in 1866 and commander in 1874. He was made commodore in 1898 and in 1899 was retired with rank as rear-admiral.

Robespierre, rō-bēs-pē-ār or rō'bēs-pēr, **Maximilien Isidore François Marie**, French revolutionist: b. Arras 6 May 1758; d. Paris 28 July 1794. He was the son of an avocat and having been left an orphan at 11 was sent by his grandfather to the college of his native town, from which he passed in 1770 to the Collège Louis-le-Grand at Paris on a scholarship given him by the Bishop of Artois. After pursuing the study of law with great distinction, he returned, in 1781, to Arras, where he adopted the profession of avocat. Solid, rather than brilliant, he quickly became known as a skilful lawyer and a man of unimpeachable integrity. With growing success he gave much of his time to the dilettante pursuit of literature, wrote essays in competition for prizes offered by the provincial academies and was a prominent member of the Rosati, a society devoted to the cultivation of wit and letters. He was an ardent student of Rousseau and a fanatical believer in the teachings of the Genevan philosopher; indeed Robespierre's unwavering convictions in the possibility of realizing Rousseau's ideal society explains his course in the days when he stood forth as the greatest figure in France, and gives the secret of his temporary success. In the events leading up to the election of the States-General Robespierre appeared prominently as the champion of the liberal views then so widespread among the French bourgeoisie. He was elected fifth deputy to the States-General from Artois, and allied himself with the radical faction in that body. In the constituent assembly he spoke frequently and always in the spirit of that equality which he believed was now at length to be established in France. Of small stature and by no means robust health, weak-voiced and pale-eyed, he did not impress himself on the mass of the assembly, but those who came into personal contact with him were gained over by his tremendous sincerity, and Mirabeau said of him: "That young man believes what he says; he will go far." Robespierre's great strength, however, was in the club of the Jacobins, where his polished, classical declamations gained him the ardent support of those members who had been recruited from among the working classes and the small bourgeoisie of Paris. His power in the club became absolute when the more conservative members seceded in 1791, after the more radical faction, under the inspiration of Robespierre, had prepared the petition for the deposition of Louis XVI., which led to the massacres in the Champ de Mars on 17 July. His popularity was demonstrated on the day of the dissolution of the National Assembly, 30 Sept. 1791, when Robespierre and Pétion were drawn in triumph through the streets of Paris, and crowned as "incorruptible patriots" by the people. In accordance with his own motion, adopted in May 1791, prohibiting members of the constituent assembly from sitting in the succeeding legislature, Robespierre took no direct part in the sessions of that body, but he continued to wield great

influence over its deliberations through his power in the Jacobine. In February 1792, he became public prosecutor at Paris, but resigned the office in April on account of the virulent attacks of the Girondists, who regarded him with special hatred because of his opposition to their favorite policy of war against Austria. Robespierre's opposition to the war was based on humanitarian grounds; he was, besides, a man of theories and not of action, and this would explain the little share he took in the uprisings of 20 June and 10 August, which, under the guidance of Danton, effected what Robespierre was quite pleased to see consummated, the overthrow of the Bourbon monarchy. Shortly after the storming of the Tuileries, Robespierre became a member of the Paris Commune; his personal popularity lent strength to that body, but his inability to prevent the prison massacres of September showed that his power was by no means absolute in the ranks of the radical party.

In the Convention to which he was elected as the first deputy from Paris, Robespierre became the leader of the Mountain. The Girondists turned the full force of their eloquence against him, and accused him of aiming at the dictatorship. In the crisis which attended the trial of Louis XVI., Robespierre for once assumed a firm and definite line of action. He pleaded for the death of the king and by so doing gained over to his side the party of Danton, Carnot and Bellaud-Varenne, who were disgusted by the temporizing policy of the Girondists at a time when France was in imminent danger of foreign invasion and needed a strong government to make headway against her enemies. The condemnation of Louis XVI. was a triumph for Robespierre, who, however, did not cease from his attacks on the Girondists. The struggle became one of life and death. In April, Robespierre denounced them in the body of the Convention, and on the fateful days of 31 May and 2 June the destruction of the party was accomplished with the aid of the Parisian mob. (See GIRONDIST.)

In July 1793, Robespierre was made a member of the Committee of Public Safety, which for a year was to be the virtual ruler of France. To curb dissension at home, so as to present a united front to the foreign foes of the country, the committee organized the Terror with which the name of Robespierre has become, through legend, synonymous. To the world at large Robespierre appeared as the master of the committee and the ruler of France. As a matter of fact, his power was in no way absolute. Of the 12 members of the committee, the majority were quite opposed to his Rousseauian ideals and only two of the 12, Couthon and St. Just, were professed followers of Robespierre. The rest of the committee were practical men of affairs, like Carnot, Bellaud-Varenne, or Collot d'Herbois, upon whose shoulders fell the real task of government. Robespierre's services to the committee were such as his immense popularity and spotless reputation could render it. He was the apologist for the committee in the Convention and before the people, but he differed from his associates entirely so far as the motives of his action are concerned. While the Terror to them was but a thorough, though possibly radical, means for establishing peace within the country, Robespierre saw in the Terror an effective

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instrument for bringing about the erection of Rousseau's ideal state, by wiping out all opposed to his favorite theories. He first turned against Hébert (q.v.) and his followers in the Paris Commune, who had aroused his enmity by their uncompromising democracy, in their display of which they were guilty of the most ridiculous excesses, and their professed atheism, which attained its climax in the establishment of the worship of Reason by Chaumette (q.v.). The Hébertists were brought to the scaffold on 24 March 1794, and they were followed by Danton, Camille Desmoulins and their followers on 5 April. On 13 April came the turn of Chaumette. Danton fell because he had begun to advocate a moderation of the Terror and thereby had incurred the enmity both of the men of action on the Committee of Safety and of Robespierre, to whom alike the continuance of the Terror seemed essential. To hasten the work Robespierre caused the infamous law of the 22 Prairial (10 June) to be proposed by Couthon, whereby the revolutionary tribunal was freed from all restrictions of legal procedure, and thus improved sent nearly 1,300 persons to the scaffold between 12 June and 28 July.

On 8 June Robespierre attained the zenith of his career, when, as president of the Convention, he celebrated with great pomp the Feast of the Supreme Being, whose existence had been formally admitted by the Convention in the preceding month. His fall followed speedily. The men on the Committee of Safety who had suffered his official leadership as long as he was content to remain largely a figure-head, turned upon him when he began seriously to assert mastery over the committee. Besides, it became apparent that the excesses of the Terror could not go on, and that reparation would be demanded, and Robespierre was chosen as the scapegoat of the committee. The attack on Robespierre began 17 June, when Vadier, a member of the committee of general security, satirized him before the Convention. Instead of joining battle, as he was urged to do, Robespierre went into retirement for more than a month to prepare his defense. On 26 July he appeared in the Convention and declared that the Terror should cease, and that the committees of public safety and general security should be reorganized. Ominous threats appeared in his oration, which for a time held the Convention terror-stricken, and caused it to vote his proposition. Quickly, however, he was assailed by various orators, the Convention reconsidered its action, and in the session of the following day, the 27 July, the fateful 9th Thermidor, the secret intrigues of his associates on the committee, the fear of his intended victims and the resentment of the Dantonists, who had not forgotten the death of their leader, fell upon Robespierre. His arrest was ordered and with him that of St. Just, Couthon, Lebas, and his younger brother, Augustin Robespierre. Rescued by the national guards under Henriot, and brought to the Hôtel de Ville, the great Terrorist showed no capacity for action. The Convention placed him outside of the law, and despatched a portion of the national guard under Barras against him. In the assault Robespierre was shot in the jaw by a gendarme and taken in a pitiful condition to prison. On the following day he was brought before the revolutionary tribunal and with Couthon and St. Just and

others of his followers was sent to the guillotine. Consult: Aulard, 'La Société des Jacobins' (1891); Hamel, 'Vie de Robespierre' (1865-7), the principal authority; Belloc, 'Robespierre' (1902); Morse-Stephens, 'Principal Speeches of the Orators and Statesmen of the French Revolution' (1892).

Robin, a name originally applied in England to the red-breast (q.v.), a bird so familiar and so dear to the English heart that loyal colonists in many parts of the world have felt impelled to transfer the name to native species, which often resemble the original in little but the ruddy breast. The American robin is a true thrush (*Merula migratoria*) of the family *Turdidae*, and is found in summer throughout North America from Alaska to Virginia. Robins retire from higher latitudes only as their food begins to fail, or when driven south by inundating snows. During the winter months they are numerous in the Southern States, but even as far north as Boston robins are sometimes seen assembling round the open springs wherever berries may be found in the depth of winter. In the New England and the Middle States the robin is perhaps the most abundant breeding bird. Their nests of mud and grass are often seen on the horizontal branch of an apple tree, or in a shade tree, especially evergreens. The eggs, about four, are of a pale bluish-green, and without spots. They raise several broods in a season.

Robins feed upon insects, ripe cherries and other small fruits, but are especially fond of earthworms, which they extract from their burrows in the early morning and late afternoon with the greatest skill and industry, and of which they devour vast quantities. In spite of the fact that fruit growers consider them harmful, the cheery whistle and vivacious manners of the robin are rapidly gaining for it a place in popular esteem analogous to its English namesake. Unfortunately there are still parts of the country, and particularly of the South, where a sordid interest leads to the slaughter of great numbers of robins for the pot. In North Carolina they are killed at night in their roosting places. On the Pacific coast the robin varies to the sub-species *propinqua*, and in lower California a distinct species (*M. confusus*) occurs. *Hesperocichla naevia* is sometimes called the Oregon robin.

Robin Adair, a-dār, or **Eileen Aroon**, a familiar air, which, with the original words, was written, tradition says, by one Carroll O'Daly, an Irishman, of Elizabeth's time. However that may be, it was first popularized in England in the latter 18th century by Tenducci, an original singer in Dr. Arne's 'Artaxerxes.' Tenducci probably learned it in Ireland; at least it is known that he sang 'Eileen Aroon' with Irish words which had been phonetically arranged for him. The 'Robin Adair' form obtained currency through its rendering by Brahms at his benefit in London in 1811. Brahms's version was introduced by Boildieu into the latter's opera of 'La Dame Blanche.' Beethoven made a trio arrangement of it, with accompaniment by pianoforte, violin and 'cello.

Robin Goodfellow. See PUCK.

Robin Hood. See HOOD, ROBIN.

Robin Snipe, the red-breasted sandpiper or knot (*Tringa canutus*) in its summer plumage. This is among the largest of the sand-

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pipers, and is distinguishable by the long, perfectly straight beak combined with the absence of webbing from between the toes, the middle one of which is much shorter than the tarsus. It is upward of 10 inches long and stoutly built, with rather short stout legs. In breeding plumage the entire under parts are reddish brown, and the autumn young, which are abundant during the gunning season, have the breast and belly whitish tinged with red, and the back very characteristically marked with white and black semicircles. Such seasonal changes in coloration are unusual among the *Scolopacidae*. The knot is nearly cosmopolitan, breeding in high northern latitudes and wintering in the southern hemisphere. It passes through the United States in April and May, and again more leisurely in August to October, frequenting the seashore in small flocks, and, less commonly, the large rivers and lakes of the interior. Its habits are similar to those of the other sandpipers (q.v.), with which it associates. Because of its large size it is a favorite with gunners, among whom it is known in the autumn plumages as the gray-back.

Robins, rōb'inz, Benjamin, English mathematician: b. Bath 1707; d. Fort Saint David, Coromandel coast, India, 29 July 1751. He early became known as a mathematician of unusual ability, and in 1728 published a confutation of the veteran Johann Bernouilli (q.v.), who had attempted a defense of Leibnitz's theory as to the laws of motion relative to bodies impinging on one another. After some time spent as a private instructor in mathematics and physical science, he turned engineer, and made particular study of fortifications and gunnery. He published in 1742 his 'New Principles of Gunnery,' which he had undertaken by way of furthering his unsuccessful candidacy for the professorship of fortification at Woolwich. It was translated into German and French, and has been regarded as the starting point of the modern scientific study of the matter. Much of it was derived from personal experiment with gunpowder. In 1749 he was made engineer-general to repair the forts of the East India Company. He wrote several political pamphlets, which brought him into some notice. In 1761 'Mathematical Tracts,' containing the 'Principles of Gunnery,' appeared under the editorship of James Wilson. There were subsequent editions. Consult the memoir by Wilson in this collection.

Robins, Edward, American author: b. Pau, France, 2 March 1862. He was educated at a military academy in Philadelphia, and in 1883 engaged in newspaper work. He was on the editorial staff of the Philadelphia *Public Ledger* in 1884-8, 1895-7, and has since devoted himself to authorship. He has published, besides several juvenile works, 'Echoes of the Play House' (1895); 'Twelve Great Actors' (1900); 'Romances of Early America' (1902); etc.

Robins, Elizabeth. See PARKES, ELIZABETH ROBINS.

Robinson, rōb'in-sōn, Agnes Mary Frances. See DARMESTER, AGNES MARY FRANCES ROBINSON.

Robinson, Albert Gardner, American journalist: b. Winchester, Mass., 21 Feb. 1855. He was engaged in commercial pursuits in 1871-98, but in 1898 became special war correspondent for the New York *Evening Post* in Cuba and Porto

Rico. He subsequently went to the Philippines and South Africa in the same capacity. He has published 'The Porto Rico of To-day' (1899); 'The Philippines—the War and the People' (1901); 'Historical Review of the Period of Intervention in Cuba'; etc.

Robinson, Beverley, American Loyalist soldier: b. Virginia 1723; d. Thornbury, England, 1792. He was a major under Wolfe at the taking of Quebec in 1759, and at the commencement of the Revolution was a large landed proprietor on the Hudson. He was opposed to the measures of the British ministry respecting the colonies, and abandoned the use of imported merchandise. Nevertheless, he remained loyal, and reluctantly entered the military service of the crown. The Loyal American regiment was recruited largely by him, and he was made its colonel. He was connected with the negotiations preliminary to Benedict Arnold's treason; and at the time Arnold was occupying as headquarters Robinson's country-seat. At the conclusion of the war he went to New Brunswick, where his name appears as a member of the first council, though he never took his seat; and thence to England. He lost his property by confiscation, and by way of compensation received £17,000 from the English government. Consult: RYERSON, 'The Loyalists of America and Their Times' (1880).

Robinson, Charles Mulford, American author: b. Ramapo, N. Y., 30 April 1869. He was graduated from the University of Rochester in 1891, was editor of the Rochester *Post-Express* in 1891-1902, and has published: 'The Improvement of Towns and Cities' (1901); 'Modern Civic Art' (1903); etc.

Robinson, Charles Seymour, American Presbyterian clergyman and hymnologist: b. Bennington, Vt., 31 March 1829; d. New York 1 Feb. 1899. He was graduated from Williams College in 1849, studied at Union Theological Seminary and at Princeton, and was ordained in the ministry in 1855. He held a pastorate in Troy 1855-60, and thereafter was pastor of various churches in New York with the exception of 1868-70, when he had charge of the American Chapel, Paris, France. He published several volumes of sermons and other works, and is widely known as a collector of hymns. His publications include: 'Songs of the Church' (1862); 'Church Work' (1873); 'The Pharaohs of the Bondage and the Exodus' (1887); 'New Laudes Domini' (1892); 'Annotations on Popular Hymns' (1893); 'Simon Peter: Later Life and Labors' (1894); etc.

Robinson, Edith, American novelist: b. Massachusetts 1858. Her literary work is partly of a juvenile character and includes: 'Forced Acquaintances' (1887); 'A Little Puritan Rebel' (1898); 'A Little Puritan Pioneer' (1901); 'A Puritan Knight Errant' (1902); etc.

Robinson, Edward, American Biblical scholar: b. Southington, Conn., 10 April 1794; d. New York 27 Jan. 1863. Graduated from Hamilton College in 1816, he went in 1821 to Andover to publish his edition of books, i.-ix., xviii., and xix. of the 'Iliad,' there aided Moses Stuart (q.v.) in the preparation of the second edition (1823) of the latter's 'Hebrew Grammar,' and rendered into English (1825) Wahl's 'Clavis

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Philologica Novi Testamenti. After European study, largely in Halle and Berlin (1826-30), he was professor extraordinary of sacred literature in the Andover Theological Seminary in 1830-3, and professor of Biblical literature in Union Theological Seminary from 1837 until his death. In 1838 and 1852 he visited Palestine with the scholarly missionary, Eli Smith (q.v.), and there made careful surveys and investigations. His chief work, *'Biblical Researches'* (1841; 3 vols. compressed into 2, with a 3d 1856), which obtained for him the Royal Geographical Society's gold medal, was based on these studies. He was a leading member of the American ethnological, geographical and Oriental societies, and edited in 1831-4 the *'Biblical Repository,'* in 1843 the *'Bibliotheca Sacra,'* with which the *'Repository'* was incorporated, and for which he continued to write until 1855. Among his other publications are: *'A Dictionary of the Bible'* (1833); editions of Buttmann's *'Greek Grammar'* (1833; 3d ed. 1851) and Gensenius' *'Hebrew Lexicon'* (1836; 5th ed. 1854); and Greek (1845; 2d ed. 1851) and English (1846) harmonies of the Gospels. Consult: Hitchcock, *'Life, Writings and Character of Edward Robinson'* (1863).

Robinson, Edward Arlington, American poet: b. Head Tide, Maine, 22 Dec. 1869. He was educated at Harvard and has published *'The Torrent and the Night Before'* (1896); *'The Children of the Night'* (1897); *'Captain Craig'* (1902), collections of verse which display much promise.

Robinson, Sir Frederick Philipse, English soldier: b. near New York Sept. 1763; d. Brighton, England, 1 Jan. 1852. He became ensign in 1777 in a Royalist American regiment, raised by his father, and fought in the battles of Horse-neck, Stony Point and New London. He returned to England in 1784; entered the West India service in 1793 and was present at the capture of Martinique, St. Lucia and Guadeloupe. He became colonel in 1810, and commanded a brigade in the Peninsula campaign of 1813, where he fought gallantly; was promoted major-general in 1814 and rewarded with a medal. He took part in the engagement before Plattsburg in 1814 during the war with the United States, and in 1816 left Canada for the West Indies, where he was put in command of the troops in the Windward and Leeward Islands and for a time was governor of Tobago. At the time of his death he was the soldier of longest service in the British army.

Robinson, Frederick William, English novelist: b. London 23 Dec. 1830; d. there 6 Dec. 1901. He was educated at Clarendon House, Kennington, and in 1851 began his career as a novelist, though he frequently contributed special articles to periodicals and for five years wrote dramatic criticisms for the *Daily News*. He founded and edited *'Home Chimes,'* which ran as a weekly two years and then became a monthly. He was a prolific writer and over 50 titles of novels stand to his credit. Some of them are as follows: *'The House of Elmore'* (1855); *'One and Twenty'* (1858); *'No Church'* (1861); *'Female Life in Prison'* (1862); *'A Woman's Ransom'* (1864); *'Beyond the Church'* (1866); *'Stern Necessity'* (1870); *'Her Face Was Her Fortune'* (1873); *'Second Cousin Sarah'* (1874); *'The Romance*

of a Back Street' (1878); *'Lazarus in London'* (1885); *'The Keeper of the Keys'* (1890); *'The Secretary'* (1895); *'Sweet Nineteen'* (1896). His skilfully constructed and fluently told fictions were as popular in this country as in his own.

Robinson, Henry Crabb, English barrister and diarist: b. Bury St. Edmunds 3 May 1775; d. London 5 Feb. 1867. In 1796 he entered a solicitor's office in London, and in 1800 went to Germany, where he spent five years in studying at Jena and elsewhere, and in making the acquaintance of Goethe, Schiller, Wieland, Herder, Kotzebue, and other noted Germans. In 1807 he went to Altona as *Times* correspondent, and in 1808-9 was war correspondent in Spain for the same newspaper. He was called to the bar in 1813, and practised until 1828. He was associated with the foundation of the University of London in 1828. His fame as a conversationalist approached that of Rogers, but he never made any serious attempt to gain distinction as a writer. His intimate acquaintance with many of the greatest men and women of his time, both in his own country and on the Continent, gives peculiar interest and value to the selections from his *'Diary, Reminiscences, and Correspondence,'* edited by Sadler in 1869.

Robinson, John, English Independent clergyman: b. Lincolnshire about 1576; d. Leyden, Holland, 1 March 1625. It has been widely assumed that he was educated at Corpus Christi College, Cambridge. He was, say certain later writers, suspended from a benefice in Norfolk. He himself mentions a residence in Norwich, where he was religious director of a band of worshippers, and where certain persons were excommunicated for their interest in his instruction. In 1608 he emigrated to Amsterdam, with several of the congregation of the church at Scrooby Manor, Nottinghamshire, and thence in 1609 to Leyden, where he was ordained pastor, with William Brewster (q.v.) as ruling elder. In 1611 a building was purchased for 8,000 guilders for use as a meeting-house. Mather in his *'Magnalia'* says that "those famous divines, Polyander and Festus Hommius, employed this our learned Robinson to dispute publicly in the University of Leyden against Episcopius, and the other champions of that grand choke-weed of true Christianity" (Arminian doctrine). There may be some foundation for the story of such a disputation; but it was probably not at Polyander's request, nor at the university, where Episcopius was in power. Robinson was admitted to the university in 1615, and attended Episcopius' lectures. He took a very active interest in the project for emigration to America; and had a majority of his church volunteered, would have accompanied them hither. Previous to the sailing of the *Speedwell*, he preached on 21 July 1620, observed as a day of prayer and humiliation. His celebrated address is given in Winslow's *'Hypocrisy Unmasked'* (1646), the author remarking that Robinson "used these expressions, or to the same purpose," and some allowance must be made for such improvements and embellishments as Winslow may have made to suit his controversial purpose. Robinson corresponded with the "church of God at Plymouth, New England." Mather calls him "a most wise, grave, good man," and Robert Baillie, "the most learned, polished, and modest spirit" among

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the separatists. His 'Works,' with memoir and notes of Robert Ashton, appeared in 1851. Consult also: Bradford, 'History of Plymouth Plantation' (Coll. of the Mass. Hist. Soc., 4th ser., Vol. III., 1856); Mather, 'Magnolia' (1702); Neal, 'History of New England' (1720); Brook, 'Lives of the Puritans' (1813); Dexter, 'Congregationalism of 300 Years' (1880); 'Life' by Davis (1903).

Robinson, John Cleveland, American soldier: b. Binghamton, N. Y., 10 April 1817; d. there 18 Feb. 1897. He entered West Point in 1835, but withdrew in 1838 to study law, accepting, however, a commission as 2d lieutenant in 1839. He was engaged in the Mexican and Seminole wars, was promoted captain in 1850 and at the outbreak of the Civil War was commissioned colonel of volunteers. He was in command of Fort McHenry at the opening of the war; successfully defended it, and was later engaged in organizing volunteer troops. He commanded a brigade in the Army of the Potomac in the Seven Days' battle before Richmond; was present at the battles of Fredericksburg, Chancellorsville, Gettysburg, Wilderness, and Spottsylvania, and in the last lost a leg and was prevented from further active service. He was voted a medal of honor by Congress; was brevetted major-general of volunteers in 1864, and of regulars in 1865. In 1866 he was mustered out of the volunteer service and accorded rank as colonel in the regular army. He was in command of the Department of the South in 1867, of the Lakes in 1868-9, and in the latter year was retired with rank of major-general. He was elected lieutenant-governor of New York in 1872, was commander-in-chief of the G. A. R. in 1877-8, and president of the Society of the Army of the Potomac in 1887-8.

Robinson, Joseph Armitage, English Anglican clergyman. He was educated at Cambridge, took priest's orders in the Established Church in 1882 and was vicar of All Saints, Cambridge, 1888-92. From 1893 to 1899 he was Norrisian professor of divinity at Cambridge, and was prebendary of Wells' Cathedral 1894-99. He was rector of St. Margaret's Westminster, 1899-1900, canon of Westminster 1899-1902, and in the year last named succeeded Dean Bradley as dean of Westminster Abbey. He has published 'A Collation of the Athos Codes of the Shepherd of Hermas' (1888); 'Appendix to the Apology of Aristides' (1891); 'The Passion of St. Perpetua' (1891); 'The Philocalia of Origen' (1893); 'Euthaliana' (1895); 'Unity in Christ' (1901).

Robinson, Lewis Wood, American naval officer: b. Camden County, N. J., 7 March 1840; d. Philadelphia, Pa., 16 Feb. 1903. He was graduated from the Polytechnic College of Pennsylvania in 1861, and entered the navy in that year as 3d assistant engineer in the West Gulf blockading squadron. He participated in the capture of Fort Jackson, Fort Saint Philip, and New Orleans; was engaged in the attack on Vicksburg and in the battle of Mobile Bay. After the war he continued in the naval service, was appointed chief engineer with rank of lieutenant-commander in 1883, became commander in 1895, captain in 1898 and in 1901 was retired with rank of rear-admiral.

Robinson, Philip (Stewart), English journalist: b. Chunar, India, 1849. He was educated

at Marlborough College, engaged in teaching and in journalism, and was special correspondent of the London *Daily Telegraph* in the Afghan and Egyptian wars. He was also special commissioner of the New York *World* in 1881-2, and during the Spanish-American war was in Cuba as correspondent of the *Pall Mall Gazette*. He has published: 'In My Indian Garden' (1878); 'Sinners and Saints' (1883); 'Some Country Sights and Sounds' (1893); 'Birds of the Wave and Woodland' (1894); 'In Garden, Orchard and Spinney' (1897); etc.

Robinson, Stillman Williams, American engineer and inventor: b. Reading, Vt., 6 March 1838. He was graduated from the University of Michigan in 1863, and for the three following years became assistant engineer in the United States Lake Survey. In 1866 he became attached to the University of Michigan in the department of geodesy and mining, and in 1870 was made professor of mechanical engineering at the University of Illinois, where he remained until 1878, when he assumed a similar post at the Ohio State University, and continued in its active duties until made professor emeritus in 1894. He has been an active inventor, and controls at least 40 patents. He invented the thermometer-graduating machine, and machines for shoe manufacturing, and has published: 'Teeth of Great Wheels and the Robinson Templet Odontograph' (1876); 'Railroad Economics' (1882); 'Strength of Wrought Iron Bridge Materials' (1882); 'Compound Steam-Pumping Engines, Analytical and Graphical Treatment' (1884); 'Principles of Mechanism' (1896); etc.

Robinson, Stuart, American Presbyterian clergyman: b. Strabane, near Londonderry, Ireland, 26 Nov. 1816; d. Louisville, Ky., 5 Oct. 1881. He was graduated at Amherst College in 1836, studied theology at Union Seminary, Prince Edward, Va., and was ordained in 1841. He was pastor at Kanawha Salines, W. Va., 1841-7, in 1856-8 professor of ecclesiology in the Presbyterian Seminary at Danville, Va., and then became pastor at Louisville. He edited the 'True Presbyterian,' which was suppressed by the government in 1862 for disloyalty, and he then removed to Toronto. In 1865 he published 'Slavery as Recognized by the Mosaic Civil Law, and Allowed in the Abrahamic, Mosaic, and Christian Church,' and in 1866 resumed his Louisville pastorate and reissued his paper as 'The True Christian Commonwealth.' His persistence in expressing his former views led to his expulsion from the Presbyterian general assembly, and by his influence the Kentucky synod joined the Southern general assembly in 1869, which body made him its moderator. He was a delegate to the Pan-Presbyterian council at Edinburgh in 1877. He wrote: 'The Church of God an Essential Element of the Gospel' (1858), and published 'Discourses of Redemption' (1866).

Robinson, Theresa Albertine Louise von Jakob, German-American author: b. Halle, Prussia, 26 Jan. 1797; d. Hamburg 13 April 1869. She was the second wife of Edward Robinson (q.v.), and was known in Germany as an author under the name of "Talvj" (formed from her initials. While residing at Kharkoff she began to study Slavonian, and wrote her

first poems. In 1825 she published a few tales in a volume bearing the title 'Psyche.' She also published, in 1825-6, translations of a number of Serbian popular songs entitled 'Volkslieder der Serben.' In America she began the study of the aboriginal languages, and translated into German Pickering's work on the Indian tongues. In 1834 she wrote a 'Historical Review of the Slavic Languages' for the 'Biblical Repository,' republished in enlarged form in 1850. During her husband's visit to Palestine she resided in Germany, where she published, in 1840, 'Charakteristik der Volkslieder germanischer Nationen mit einer Uebersicht der Lieder aussereuropäischer Völkerschaften.' 'Die Colonisation von Neuengland' was published at Leipsic in 1847; a defective translation by W. Hazlitt, Jr., appeared in London in 1851. She also wrote numerous tales, and contributed to magazines, both German and English.

Robinson, William Callyhan, American jurist: b. Norwich, Conn., 26 July 1834. He was graduated from Dartmouth College in 1854; studied at the General Theological Seminary in New York, and entered the Episcopal ministry in 1857, but later studied law and was admitted to the bar in 1865. In 1869 he became instructor in the Yale Law School, and later professor of elementary and criminal law, and the law of real property. He was judge of the court of common pleas, New Haven, 1874-6, and member of the Connecticut legislature in 1874. Since 1895 he has been dean of the law school of the Catholic University of America. He has published: 'Notes of Elementary Law' (1876); 'Elementary Law' (1882); 'Law of Patents' (1890); 'Forensic Oratory' (1893); 'Elements of American Jurisprudence' (1900).

Robinson, Ill., city, county-seat of Crawford County, on the Wabash River, and on the Cleveland, C., C. & St. L. and the Illinois C. R.R.'s; 36 miles southwest of Terre Haute, Ind. It was settled in 1842, when it became the county-seat; was incorporated as a village in 1866, and as a city in 1886. It is the trade centre of a fruit and grain growing and sheep raising region, and contains a few small mills. It has two banks, with a combined capital of \$75,000, doing business to the amount of \$800,000 annually. It contains a public high school founded in 1885, with a school library of over 500 volumes (1903), and a Carnegie library. The city government is by a mayor and a council of six; the members of the council are elected for two years, three being chosen each year. Pop. (1900) 1,683; (1910) 3,863. G. W. HARPER,

Editor of the Robinson 'Argus.'

Robinson Crusoe, a world-famous tale by Daniel Defoe, published in 1719, and supposed to have been suggested by the experience of Alexander Selkirk (q.v.), who was shipwrecked and lived for years on a desert island. Crusoe, an Englishman, goes to sea in his youth, is captured by the corsairs, is shipwrecked and washed ashore on an uninhabited island, formerly supposed to have been in the Pacific, but recently satisfactorily identified with Tabago in the Caribbean Sea. The narrative consists of a careful description of his adventures and experiences during the 28 years of his exile. The first volume ended with the return of Crusoe to England, and met with such remarkable suc-

cess that the author, four months later, brought out a second volume, entitled 'The Farther Adventures of Robinson Crusoe'; and this in turn was followed, one year later, by a third, relating his 'Serious Reflections' during his wanderings. The simplicity of style and the realistic atmosphere pervading the narrative, have caused the popularity of this book to remain unimpaired.

Robison, John, Scottish scientist: b. Baldernock, Stirlingshire, 1739; d. Edinburgh 30 Jan. 1805. He entered Glasgow University in 1750. In 1758, as private tutor to the son of Admiral Knowles, he accompanied the expedition under General Wolfe for the reduction of Canada. In this situation, besides instructing his pupil, he was employed in making surveys of the coasts and harbors on the river Saint Lawrence. In 1763 he resumed his studies at Glasgow, devoting himself to mechanics, to which he was influenced by his acquaintance with James Watts, then employed in perfecting the steam-engine. In 1766 he was appointed to the chair of chemistry in the university. Admiral Knowles having been recommended by the British government to the Empress Catharine of Russia to superintend the improvement of her navy, Robison accompanied him as private secretary in 1770. In 1772 he was appointed by the empress inspector-general of the corps of marine cadets at Cronstadt. In 1773 he accepted the chair of natural philosophy at Edinburgh, which he continued to fill till his death. His writings include 'Elements of Mechanical Philosophy' (1804); 'A System of Mechanical Philosophy' (1822); and many contributions to the third edition of the 'Encyclopædia Britannica.'

Rob'john, William James ("CARYL FLORIO"), American musician and composer: b. Tavistock, Devonshire, 2 Nov. 1843. He came to New York in 1857, and in 1858-60 was first boy soloist at Trinity Church, New York. He afterward went on the stage as a singer, was organist in several churches, and also conducted opera in Havana and in New York. He organized the Palestrina Choir in 1886, and in 1889-91 was musical director of Wells College, Aurora, N. Y. His compositions include cantatas, overtures, symphonies, chamber music, and sacred music, in addition to the operettas: 'Inferno' (1871); 'Les Tours de Mercure' (1872); 'Suzanne' (1876); and the operas: 'Gulda' (1879); and 'Uncle Tom's Cabin' (1882).

Robsart, rōb'särt, Amy, a character in Scott's novel, 'Kenilworth.' She is the unacknowledged wife of the Earl of Leicester, whom she follows to the castle of Kenilworth during the queen's visit; but there she is disowned, and is returning to her original place of concealment, when she meets the death prepared for her by Richard Varney.

Rob'son, Stuart, American actor: b. Annapolis, Md., 4 March 1836; d. New York 29 April 1903. His father's name was Charles Stuart, and he was christened Henry Robson Stuart. As a boy he acted as page in the House of Representatives during the 30th and 31st Congresses. Adopting the stage as a profession, he appeared first at the Baltimore Museum in 1852. He appeared in a play with William H. Crane in 1877 at the Park Theatre, New York, and their joint success led to a 12 years' partnership, during which time they produced 'Twelfth

Night,' 'The Comedy of Errors,' and 'The Merry Wives of Windsor,' besides other comedies and farces. In 1888 Bronson Howard wrote for them 'The Henrietta,' which was also played by Robson after their partnership ended. Plays in which he appeared as an independent star were 'Is Marriage a Failure?'; 'She Stoops to Conquer'; 'The Meddler' (1898) by Augustus Thomas; 'The Jucklins' (1900) by Opie Read.

Roburite, an explosive patented by Dr. Roth in 1887. It consists of dinitrochlor-benzene mixed with ammonium nitrate, and must be used dry. The detonation of the mixture is to be effected by means of fulminate of mercury. Roburite burns quietly, and is not sensitive to shock. Its most successful use has been in the mining of coal, where it is valuable not only because it causes little dust, but also because it allows of blasting the coal in large blocks.

Robusti, rō-boos'tē, **Jacopo**. See TINTO-RETTO.

Roc, rōk, a mythical bird of enormous size, supposed to have been able to perform wonderful feats of strength and ferocity. The most popular accounts of the roc are given in 'The Arabian Nights' Entertainments, where the bird plays an important part in the fortunes of Sinbad the Sailor. Sinbad describes the roc as white, with a claw as large as the trunk of a large tree and with a beak of prodigious size and sharpness. Its egg, he declares to be 50 paces in circumference, about 150 feet. Another writer computes that the egg of the roc is equal to 150 hens' eggs. The bird is described as a bird of prey, "able to bear an elephant away in its talons," and "killing the moa, which it bore to its nest and destroyed to provide food for its young." See, in 'The Arabian Nights' Entertainments, the accounts of the second voyage, and the third Calendar's Story. Attempts have been made to identify the roc with the so-called elephant-birds of Madagascar and New Zealand, but it is asserted by naturalists that neither this huge bird (which is not a bird of prey) nor the *Harpagornis*, the largest known rapacious bird, could have performed the feats commonly attributed to the roc. There was described to the Parisian Academy of Sciences the fossils of an enormous bird called the *Aepyornis* and two of its eggs, fossil remains of which had been discovered. (See reports for first quarter, 1851.) This little-known colossal has been accepted as the nearest approach to the fabulous roc.

Roca, rō'kā **Julio A.**, Argentine statesman: b. Tucuman, Argentina, 1 July 1843. He was trained in the Paraná military school, entered the army, and in 1874 became general. In 1878-80 he was war minister, and as such headed in person the expedition which subdued the Patagonian Indians. From 12 Oct. 1880 to 12 Oct. 1886 he was president of the republic. It was during his administration that the serious Argentine financial crisis occurred.

Rocafuerte, rō - kā - foo - ār'tā, **Vincente**, South American statesman: b. Guayaquil, Ecuador, 3 May 1783; d. Lima, Peru, 16 May 1847. He was educated in France and England, and in 1812 was elected to the Spanish Cortes by Guayaquil, but his opposition to the policies of Ferdinand VII. was resented, and he was obliged to escape to France. He went to Lima, and to

the United States in 1819, and in 1824 to Mexico, where he became secretary to General Michelena. He accompanied him to England, and after the recognition of Mexico's independence and Michelena's return, he remained in England as *chargé d'affaires*. In 1830 he resigned and returned to Mexico, where he edited the 'Fénix de la Libertad.' He went to Guayaquil in 1833, and was soon after elected deputy to congress for the province of Pichincha, but was exiled because of his opposition to the administration. The province of Guayaquil then revolted against General Flores and proclaimed Rocafuerte as supreme chief. He was defeated and captured by Flores, but an amicable arrangement was soon afterward made, co-operation in the reorganization of the republic was agreed upon, and Rocafuerte served as president in 1835-9. His administration was one of ability. He introduced many reforms, and placed the financial affairs of the country on a sound basis. His after life was spent in various diplomatic missions, in which he sustained his high reputation as a statesman. He wrote: 'Ideas necesarias á todo pueblo independiente, que quiere ser libre' (1820); 'Ensayo sobre tolerancia religiosa bajo el aspecto politico y como medio colonización y de progreso' (1831); etc.

Rocaille, rō-kal-ē'. See Rococo.

Roc'amboule, a species of onion (*Allium scorodoprasum*) having bulbs resembling those of the garlic; but the cloves are smaller. It is cultivated for the same purposes, and is considered as having a more delicate flavor.

Rocha Pitta, Sebastiao, sâ-bās-tē-ā'ñoō rōsh'ā pēt'tā, Brazilian author: b. Bahia, Brazil, 3 May 1660; d. near there 3 Nov. 1738. He was a leisurely student, and the author of some commonplace verse and fiction. He made very elaborate preparations for his 'Historia da America Portuguesa desde o seu Descobrimento até o Anno 1724' (1730), which won for him deserved success and numerous honors. The book was the first history of Brazil in any true sense, and the material it contained has proved of much value to subsequent workers in that field.

Rochambeau, rō-shān-bō, **Jean Baptiste Donatien de Vimeure, COMTE DE**, French marshal: b. Vendôme 1 July 1725; d. Thoré 10 May 1807. He was the son of the governor of his native town and was brought up for the church, but at 17 entered the army. He fought with distinction in the war of the Austrian Succession, attained the rank of colonel and in 1749 followed his father as governor of Vendôme. During the Seven Years' war he did excellent service in Minorca (1756) and later in Germany, winning the rank of brigadier-general. He was made lieutenant-general in 1780 and in the same year was despatched at the head of an army of 6,000 men to co-operate with the American forces in the War of Independence. In July he landed in Rhode Island and, intrenching himself at Newport, held his position till June of the following year, when, in pursuance of a plan of campaign arranged between Rochambeau and Washington, the French troops, reinforced by some 3,000 men, marched across Connecticut and joined the American army on the Hudson, whence was begun the southward march for Yorktown. The city was invested on 29 September and after two

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brilliant assaults by the French troops and the defeat of the English fleet by the French under De Grasse in Chesapeake Bay, Cornwallis surrendered. Rochambeau's services to the American cause were enhanced by the utter absence of jealousy or self-assertion on his part; he placed himself implicitly under Washington's orders and within his own army maintained the sternest discipline. Congress voted its thanks to the French commander for his valuable services and presented him with two guns taken at Yorktown. Returning to France in 1783, he took part in the earlier events of the French Revolution and after being raised to the rank of field-marshal, was given in 1791, command of the Army of the North. Regarding with disfavor the progress of the Revolutionary policy, he resigned in June 1792 and soon after was imprisoned at Paris, regaining his liberty at the end of the Reign of Terror in 1794. In 1804 Napoleon made him an officer of the Legion of Honor. A statue of Rochambeau was erected at Vendôme in 1899, and a replica of it in Lafayette Square, Washington, was unveiled with much ceremony in 1902. He left behind him, 'Mémoires du Maréchal de Rochambeau' (1890), translated, in part, into English (1838).

Rochdale, *roch'dāl*, a market-town and parliamentary borough of England, in Lancashire, 10 miles north-northeast of Manchester. The parish church of St. Chad, finely situated on a lofty height, and approached from the lower part of the town by a flight of 122 steps, is a spacious and venerable structure of the 12th century (restored in 1837), partly in the late Norman and partly in the Perpendicular style, with a square embattled tower, several windows of rich tracery, and some very ancient monuments. Rochdale is a place of considerable antiquity, and had a Roman station in its vicinity. Its woolen manufacture appears to have been introduced by the Flemings in the reign of Edward III., and having continued to flourish, is mentioned as famous in the reign of Elizabeth. The Rochdale Co-operative Store, which has about 12 branches in the town, was the first society of its kind, and has served as a model for other co-operative societies.

Rochdale Pioneers, or **Rochdale Society of Equitable Pioneers**. See CO-OPERATION.

Roche, *röch*, **Alexander**, Scottish artist: b. Glasgow 17 Aug. 1863. He began life as an architect, but turning his attention to painting, studied at Paris, and is now corresponding member of the Munich Secession. He has painted in landscapes and genre, and among his pictures are: 'Tête-a-Tête,' which carried off a gold medal at Munich in 1889; 'Fishers' (1891), bought by the Berlin Gallery; 'Landscape,' awarded a gold medal at Dresden (1897); 'Prue' (1902), bought by the Munich Gallery. He also executed the frescoes in the Banqueting Hall, Glasgow Municipal Building, 1900. He has published 'Finish in Art' (Transactions of the National Association for the Advancement of Art, 1889).

Roche, **James Jeffrey**, American author and editor: b. Mountmellick, Queen's County, Ireland, 31 May 1847. He was taken to Prince Edward's Island in infancy, was educated at Saint Dunstan's College, Charlottetown, and in 1866-83 was engaged in commercial pursuits in

Boston. In 1883-90 he was assistant editor of the Boston 'Pilot,' of which he has been editor-in-chief since 1890. He has published: 'Songs and Satires' (1886); 'The Story of the Filibusters' (1891); 'Her Majesty, the King' (1898); 'By-ways of War'; etc.

Roche, **Regina Maria (Dalton)**, Irish novelist: b. south of Ireland about 1764; d. Waterford 17 May 1845. She attained sudden fame in 1798 by the publication of her four-volume story, 'Children of the Abbey,' much in the fashion of the 'Mysteries of Udolpho,' which it rivaled in popularity. She then set to work on a long series of similar books — 'The Nocturnal Visit' (1800); 'The Tradition of the Castle' (1824); 'The Nun's Picture' (1834), and a dozen others.

Roche, *rösh*, **Troilus de Mesgouat**, **MARQUIS DE**, French colonizer in America: b. France 16th century; d. Brittany after 1600. In 1598 he received from Henry IV. letters-patent creating him lieutenant-general of Canada and adjacent islands, with power to establish colonies anywhere in North America. With a crew drawn largely from French prisoners, he set sail with one Chedotel of Normandy as pilot. After landing 40 of his force on Sable Island, he explored Acadia. Head winds prevented a landing at the island, on his return; and sailed on for France, where he was impressed for a year. Chedotel was ordered to go in search of the 40 followers, who had fortunately made their escape by means of wrecked vessels found on the coast.

Rochefort, **Henri**, *ön-rē rösh-för* (**VICTOR HENRI, MARQUIS DE ROCHEFORT-LUCAY**), French journalist and politician: b. Paris 31 Jan. 1831. He became known as the author of successful vaudevilles and farces and as a contributor to *Charivari*, *Figaro*, and other Parisian periodicals, wherein his political reviews were marked by a brilliancy of wit and audacity of attack that brought upon him the resentment of the government. His assaults on Napoleon III. led the emperor to demand his expulsion from the staff of *Figaro*. Rochefort thereupon (1868) founded a weekly of his own, 'La Lanterne,' in which he continued his assaults on the government with unrivaled weapons of sarcasm and ridicule, beneath which the emperor and his ministers were helpless. The 'Lanterne' attained an enormous circulation, and when the editor was forced by repeated sentences of the courts to take refuge in Belgium, he continued its publication in a spirit all the more acrimonious. In 1869 he was elected to the Corps Législatif, and established the 'Marseillaise' with the professed object of combating the Second Empire. In January 1870 he was imprisoned for inciting to insurrection. After the fall of the Empire he became a member of the government of national defense, but was out of sympathy with the conservative tendencies of that body and strongly inclined to the radical element that afterward brought forth the commune. In May 1871 Rochefort fled from Paris, but was captured and sentenced by a court-martial to deportation. In 1873 he was transported to New Caledonia, but escaped in the following year, lived in Belgium and Switzerland, and renewed the publication of the 'Lanterne.' In 1880 he returned to Paris and founded the 'Intransigeant,' a periodical of virulent protest. He was deputy in 1885-6, be-

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came an ardent supporter of Boulanger, and in 1889 was sentenced to imprisonment, but escaped to England. He returned under amnesty in 1895, and attracted public attention as one of the most violent opponents of Captain Dreyfus (q.v.) in that celebrated affair. He published 'Les Aventures de ma Vie' (1896).

Rochefort, or **Rochefort-sur-Mer**, France, chief city of an arrondissement of the department of Charente Inférieure. It is notable for its naval and army institutions, and its well-built public works. It has two harbors—military and commercial. Napoleon purposed embarking for America from this point, but his plans were frustrated. The manufactures include tiles, beer, candles, artificial flowers, naval clothing. There are also various metal foundries, etc.

Rochefoucauld, rōsh - foo - kō, **François**, DUC DE LA. See LA ROCHEFOUCAULD.

Rochegrosse, **Georges**, zhōrzh rōsh-grōs, French painter: b. Versailles 1859. He studied at Paris, and developed under Lefebvre and Boulanger a powerful naturalistic style with an almost startling brilliancy of technique. His tendency to the brutal side of tragedy in his choice of subjects is, however, frequently revolting, and his pictures too frequently swim in blood. Among the best known and most characteristic are: 'The Death of Geta, Emperor of Rome,' and 'The Fall of Babylon.'

Rochejacquelin, rōsh-zhāk-lān, **Henri de la**. See LA ROCHEJACQUELIN.

Rochelle, rō-shēl', Ill., city in Ogle County; on branches of the Chicago, Burlington & Quincy railroad; about 70 miles west of Chicago, and 150 miles north of Springfield. It is the commercial and trade centre of a fertile agricultural region, in which stock-raising is an important industry. The manufacturing interests are connected with farm products. It has a high school, public elementary schools, and a public library. Pop. (1910) 2,732.

Rochelle, **La**, la rō-shēl', France, chief town of the Charente-Inférieure, a fine port and strongly fortified. It carries on a trade, the value of whose imports amounted in 1899 to almost \$13,000,000; its exports to more than \$5,000,000. Rochelle played an important role in the Reformation period, resisting many assaults, but was finally forced by famine to succumb (1628).

Rochelle Salt, sodium potassium tartrate, a white crystalline substance, discovered by Seignette, an apothecary of Rochelle, France. It has a mildly saline and slightly bitter taste, and is much used as a laxative, especially in seidlitz powders.

Roches Moutonnées, rōsh moo-tō-nā', bosses of rock smoothed and rounded by glacial action. Such protuberances occur as scattered knobs and undulating surfaces in former glacial areas. Those little acted on by the weather generally show the characteristic glacial scratches and groovings. Some are smoothed and polished all over, and have the appearance of whales' or dolphins' backs; others are smoothed only on the side which faces the direction from which the glaciating agent flowed; the other side, protected from abrasion, being left in its rough unpolished condition. The name is fancifully

applied because such rocks in a valley bottom, when seen from above, have a seeming resemblance to the rounded backs of sheep lying down.

Rochester, rōch'ēs-tēr, **John Wilmot**, 2D EARL OF, English poet and courtier: b. Ditchley, Oxfordshire, 10 April 1647; d. Woodstock Park, Oxfordshire, 26 July 1680. On his father's death in 1658 he succeeded to his titles and estates, the latter of which he soon dissipated. Having studied at Oxford, he served with credit in the fleet under Lord Sandwich at the attack on Dutch ships in the harbor of Bergen, but subsequently gave himself up to dissipation, and became the personal friend and favorite of Charles II., who is said to have encouraged and shared many of his exploits. He frequently fell into disgrace at court, though his pardon was not long in forthcoming. His constitution at length gave way, and at 30 he was visited with all the debility of old age. He lingered for some time in this condition, and died, after sending for Bishop Burnet and professing great penitence for his misspent life. The volume of obscure verse purporting to be his contains much that is spurious. He was no better and rather worse than the lax writers of his day; but the edition of his poems brought out by his friends in 1691 contains such exquisite lyrics as entitle him to rank as the best song writer between Carew and Burns. He wrote the famous epigram on Charles II., asserting he "never said a foolish thing and never did a wise one."

Rochester, **Nathaniel**, American pioneer: b. Cope Parish, Westmoreland County, Va., 21 Feb. 1752; d. Rochester, N. Y., 17 May 1831. Having gone in 1763 to Granville County, N. C., he was made a member of the committee of safety for Orange County in 1775, in 1776 was a member of the first provincial convention in North Carolina, and was appointed by the convention a deputy commissary-general of military and other stores. He soon afterward resigned and was elected to the North Carolina legislature. In 1783 he established various manufacturing enterprises at Hagerstown, Md., and in Maryland became a member of the assembly, judge of the county court, and a presidential elector. Independently and in association with others, he purchased tracts of land in western New York, including (1802) one of 100 acres in Falls Town. He removed (1810) to Livingston County, near Dansville, and (1815) to Bloomfield, Ontario County. In April 1818 he went to Falls Town, which had been named Rochester in his honor; and in 1821-2 was the first representative of Monroe County in the State legislature. Consult Rochester, 'Early History of the Rochester Family in America' (1882).

Rochester, England, in the county of Kent, a river port on the Medway, 29 miles southeast of London. Its ancient castle (11th century) on an eminence overlooking the river, commands the view of a vast expanse of the surrounding country. The great tower of this ruined castle is one of the finest specimens of Norman architecture extant. The cathedral founded by Saint Augustine in 604 presents a mixed style, as it was destroyed by the Danes, and parts were added and remodeled subsequently at various epochs. There are many monuments of great antiquity. Of secular buildings, the town hall, exchange, municipal buildings

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1. The Falls of the Genesee, Upper Falls.

2. The Falls of the Genesee, Lower Falls.

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and almshouses, schools, and Working Men's Institute are the most important. There is a large shipping trade, a steam-engine manufactory, and other industrial establishments, and lucrative oyster fishing. The town was founded by Ethelbert. The castle was built by Henry III. Henry VIII. visited Rochester, accompanied by Charles V., and Elizabeth spent five days there in 1573. Dickens introduces Rochester into 'Pickwick,' 'Edwin Drood,' and others of his novels.

Rochester, Minn., city, county-seat of Olmsted County; on the Zumbro River, and on the Chicago & N. and the Chicago and G. W. R.R.'s; about 92 miles southeast of Saint Paul and 45 miles west of Winona. It was settled in 1854 by James Bucklin and Mr. Proudfoot, and incorporated as a city in 1858. The city was visited by a cyclone in 1883, which caused the death of 27 persons and the loss of a large amount of property. It is in a productive agricultural region, in which wheat is one of the principal crops. Considerable attention is given to stock-raising. The chief manufacturing establishments are flour and grist mills, a foundry, and machine shops. There are large grain elevators and stock yards. The principal buildings are the court-house, municipal building, Masonic Temple, Odd Fellows' building, opera house, Saint Mary's Hospital, a number of churches, and the convent of the Sisters of Saint Francis. The educational institutions are the high school, public and parish elementary schools, private commercial schools, Notre Dame de Lourdes Academy (R. C.), founded in 1877, and four libraries. The three banks have a combined capital of \$200,000; and the annual business amounts to \$1,500,000. The government is vested in a mayor, alderman-at-large, and a council of six members, three of whom are chosen by popular vote each year. Pop. (1910) 7,844.

A. W. BLAKELY,
Editor 'Post and Record.'

Rochester, N. H., city in Strafford County; on the Cochecho and Salmon Falls rivers, and on four railroads, all operated by the Boston & Maine railroad; about 30 miles east by north of Concord, and 35 miles northeast of Manchester. It was settled in 1722 by emigrants from England; incorporated as a town in 1722 and chartered as a city in 1891. It is the commercial and industrial centre of a large part of Strafford County; the chief manufacturing establishments are shoe factories, which have 1,000 employees; woolen mills, 400 employees; brick works, box factories, and other manufactories having fully 500 employees. The trade is chiefly in its own manufactures and in farm products. The principal public buildings are the Gaffney Home for the Aged, the 13 church buildings, and the schools. The educational institutions are a high school, public and parish schools, private commercial schools, and a public library. The three banks have a combined capital of \$150,000. The government is vested in a mayor and a council of 18 members. The members of the council hold office three years, six being elected each year. Pop. (1910) 8,868.

WILLIS M. DUFFEE,
Editor 'Rochester Courier.'

Rochester, N. Y., city and county-seat of Monroe County, on the Genesee River and

the Erie Canal, and on the New York Central and Hudson River, the West Shore, the Lehigh Valley, and the Erie, and other railways; 229 miles west of Albany. Almost in the centre of the city are the Upper Falls of the Genesee. The city lies on a plateau, 263 feet above Lake Ontario, and is built on both sides of the river.

The Genesee River.—Midway through Rochester runs the Genesee, which is spanned by 10 bridges within the city limits, the middle one of which, built of stone, is enclosed by stores on both sides, but the others, of iron construction on stone piers, are open, affording beautiful and diversified views of the river, particularly from the northernmost bridge, whence can be seen a winding gorge nearly 200 feet deep. The sides of this display several distinct geological strata, showing the gradual formation of the earth, the red Medina sandstone being plainly visible as it rises from the water's edge for more than half the height of the precipice, when it gives place to successive layers of green shale, limestone, hematite iron ore, green and purple shale, and finally a topmost crust of limestone, all belonging to the Upper Silurian Age. At the point referred to are the lower falls, about 80 feet high, a curtain of water more beautiful, though less imposing, than the principal cataract, two miles farther back, in the centre of the city, from which, with its sheer descent of 96 feet, Sam Patch jumped to his death in 1829.

The Erie Canal.—Crossing the city from west to east is the Erie Canal, completed in 1825, which spans the river by means of an aqueduct of pleasing proportions, built of Lockport limestone at a cost of \$600,000. This canal, the surface of which at this point is 506 feet above tide-water, was, for many years after its construction, the great highway of commerce through the State, carrying to the eastern seaboard the cereal products not only of this region but of the growing West and enriching Rochester as well as other places on its banks. Wholly as a means of travel and largely as a medium of traffic its function was long ago appropriated by railroads, of which 11 enter the city.

Parks.—The Rochester Park Commission was created in 1888, since when work has been done so judiciously by the aid of the best landscape architects and nurserymen, taking advantage of the rolling lands that were obtainable, that few cities present so attractive an appearance in this regard; there are now three principal parks—the Genesee Valley, Seneca, and Highland—besides 11 smaller locations, making in all 666 acres of park territory.

Public Buildings.—There are four well-equipped hospitals—the City, Saint Mary's, the Homœopathic, and the Hahnemann—besides a municipal hospital for contagious diseases and the insane asylum, or State Hospital. There are numerous hotels—of which the largest are the Powers, the Whitcomb, the Bristol, and the Osburn—and many apartment houses, which are greatly in demand. Of legitimate theatres there are four, the Lyceum and the Cook on the east side of the river, the National and the Baker on the west. Six daily newspapers are published here—the *Democrat and Chronicle*, the *Herald*, the *Union and Adver-*

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tiser, the *Post Express*, the *Times*, and the *Abend Post*—besides a large number appearing less frequently. Of the social clubs the principal are the Genesee Valley, the Rochester, the Eureka, the Rochester Whist, and the Columbia Rifle; of literary clubs the leading ones are the Pundit, the Fortnightly, and the Wednesday Morning.

Manufactures.—Rochester was built up by the milling industry; the quality and amount of wheat grown in the valley during the early days made a demand for flouring-mills, which was strengthened by the presence of the high falls, so that those structures sprang up rapidly on both banks of the river and became so numerous that the place was long known as "the flour city" and its preeminence in this respect was recognized throughout the country. The development of the enormous wheat-fields of the West caused a decline in this business, so that its relative position was taken by the nursery industry; this was started here in 1838, after which it increased so that in 1904 there were more than 30 firms engaged in the business; besides the nurseries there are several large seed-houses, Rochester being the foremost city in the world in this regard; the first trees sent to California went from here in 1849. Rochester is the home of the camera, and practically all of the film cameras that are made in the world are manufactured here, as well as the great majority of plate cameras; in other photographic apparatus, in optical instruments, and in fruit canning it also leads all other places on the globe. Although Rochester is only the 24th city in the United States in point of population, it is the first in many things; it ranks third as to clothing, with an annual output of \$10,000,000, and fourth as to boots and shoes, with a production of \$7,000,000; its total manufacture exceeds \$70,000,000 annually, with over \$50,000,000 invested in that and the wholesale trades. The receipts at the post-office for a year are \$625,000; 640,000 tons of bituminous coal and over 360,000 tons of anthracite are consumed and shipped from here annually.

Banking and Commerce.—In the promotion of trade and in the inducement of outside manufacturers to locate in Rochester an important factor is the Chamber of Commerce, organized in June 1888, which now has a membership of 389. For providing the money necessary to carry on the business above indicated there are eight banks and five trust companies, with a combined capital of \$3,025,000, besides four savings banks, the total resources of all these institutions being \$103,124,410.73; the amount passing through the clearing-house in 1909 was \$194,385,300. For 1910 the assessed valuation of real estate was nearly \$165,500,000 (75 per cent of actual value), the tax rate \$1.93, and the net public debt \$12,742,267.

Education.—The Rochester Athenæum and Mechanics' Institute—generally known by the latter part of its title—was founded in 1885 as a free drawing-school and has so expanded that it now gives instruction in practical arts and sciences to about 4,000 pupils and ranks fourth among the technical trade schools of the country. The University of Rochester, founded in 1850 and located in beautiful grounds in the eastern part of the city, has a faculty of 23 instructors, with 264 students, and a library

of 41,000 volumes. There are also the Rochester Theological Seminary, of the Baptist denomination, founded in the same year, with a present faculty of 11, over 100 students, and 32,000 books; Saint Bernard's (Roman Catholic) Theological Seminary, occupying capacious grounds north of the city, started in 1893, having now 13 professors, 145 students, and 15,000 volumes, and the Wagner Memorial Lutheran College, chartered in 1885, having at present five professors and about 50 students. The public school system, under the control of a board of education of five members, is among the best in the country; it maintains 34 buildings, with as many principals; during 1903 there were 606 teachers, with 26,325 registered pupils; the East Side high school was lately completed at a total cost of \$322,000; the expenditures of the board are more than \$765,000. There are also 18 parochial schools and many private ones, including three academies—two of them for girls, one for boys—and one large institution for the instruction of deaf-mutes. The only free public library is the Reynolds, with 52,000 volumes, mainly books for reference and consultation.

Churches and Charities.—There are over 100 churches in Rochester. The first congregation (Presbyterian) was formed in 1815; the Roman Catholic diocese of Rochester was created in 1868. Of the seven cemeteries the oldest is Mount Hope, opened in 1838, remarkable for its natural beauty, owing to the undulations of the ground in every direction. There are five orphan asylums, three of which are under Catholic control, one under Jewish. In 1822 the Female Charitable Society was organized, from which have risen the kindred institutions of to-day, including, besides the hospitals and asylums, the Industrial School—not to be confounded with the State Industrial School, a large establishment for the reformation of young criminals—the Home for the Friendless, the Humane Society, the Children's Aid Society, the Society for the Organization of Charity, and a host of other associations for relieving distress, the most of which are connected, more or less directly, with the various churches.

Public Service.—In 1873 the Holly system of waterworks was introduced for fire protection. In the same year pipes were laid to Hemlock Lake, 28 miles away, by which water is obtained for drinking and other purposes that is unsurpassed, possibly unequalled, in its purity by any other city in the United States; 22,000,000 gallons are delivered daily; there are within the city limits 290 miles of distributing mains, with 300 miles of subsidiary pipe, and 3,050 hydrants; the total cost of the works was over \$7,500,000. The street cleaning is done by water-carts, instead of by the unsanitary means of dust-raising brooms. It is probably owing, partly, to the agencies just described that Rochester is one of the most healthful cities of the Union, the annual death rate during five years averaging 13 to the 1,000. The police force consists of 193 uniformed men; the fire department has 201 men, with 12 steamers and hose-carts, five truck companies, two chemical engines, one water tower, three separate hose companies, and one protective. The meteorological records of the past 33 years show that the mean annual temperature was 47.3, the mean maximum 55.4

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the mean minimum 39.2, the absolute maximum 99, the absolute minimum 14 below zero, the mean annual precipitation 34.5 inches, the average number of clear days annually 83, partly cloudy 126, cloudy 156.

Rochester has always been free from overwhelming calamities. The worst two disasters, financially, in its history, in neither of which was a single life lost, were the great flood of 17 March 1865, when much of the city was under water for two days, doing a million dollars' worth of damage, and the fire of 26 Feb. 1904, which devastated a large portion of the dry goods district and inflicted a loss of \$3,000,000. Rochester has a well-equipped electric street car system, with 103 miles of track, besides the lines that run to surrounding villages in every direction. There are two telephone systems in the city, one owned by a foreign corporation, the other a home enterprise, which, though new, is very successful.

History.—In 1789 a saw-mill and a grist-mill were built on the west bank of the river by Ebenezer Allan—commonly called "Indian Allan," from his life-long association with the savages—who received, as compensation for the work, from Phelps and Gorham, the owners of the land, 100 acres surrounding those pioneer structures. Though no settlement was made at the time, that tract became the nucleus of the future city. In 1803 it was bought by Col. Nathaniel Rochester, Col. William Fitzhugh, and Maj. Charles Carroll, all of Maryland, for \$17.50 an acre. Some scattered dwellings were built in the vicinity within the next few years, but no house was erected in what was then called Rochester, after the first-named proprietor, till 1812, when a log cabin was built on the spot that has ever since been known as the Four Corners. Other residences soon went up, in one of which the first white child was born, 2 Dec. 1814. Settlers from the New England States came pouring in and when the first census was taken in December 1815, the population was shown to be 331.

In 1817 it was incorporated as a village, under the name of Rochesterville, but in 1822 the title was changed to Rochester. In 1823 the size of the village was augmented by taking in a part of the town of Brighton, on the east side of the river, and subsequent additions have so increased the area that it now embraces 11,365 acres, with 325 miles of open streets, 126 miles of which are improved, with 230 miles of sewers. It was incorporated as a city in 1834, the first mayor being Jonathan Child. Rochester was the birthplace of modern Spiritualism, the famous Fox sisters having given here, in 1849, the first manifestations of mysterious rappings, which speedily became known as the "Rochester Knockings."

During slavery times Rochester was one of the centres of the Abolition movement and one of the principal stations of the "underground railroad." It was the home of Frederick Douglass, the celebrated negro orator, and was the place in which William H. Seward (q.v.), in 1858, uttered, in a public address, his memorable phrase in speaking of the struggle between freedom and slavery as an "irrepressible conflict between opposing and enduring forces."

Population.—In 1900, Rochester ranked 24 in the list of cities in the United States. The

population in 1820 was 1,502; (1825) 5,273; (1834) 12,252; (1880) 89,363; (1890) 133,896; (1900) 162,608; (1910) 218,149. This shows an increase between 1890 and 1900 of 21 per cent, and between 1900 and 1910 of 34 per cent.

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WILLIAM F. PECK,

Author of 'The History of Rochester.'

Rochester, Pa., borough in Beaver County; at the junction of the Ohio and Beaver rivers, and on the branches of the Pennsylvania railroad; about 25 miles northwest of Pittsburgh. It is connected by electric lines with Beaver, Beaver Falls, New Brighton, and other nearby places. A bridge across Beaver River connects the borough with Bridgewater. Also one across the Ohio connects the town with Monaca. It is in the coal and oil region, and in the vicinity are deposits of fire-clay and building-stone quarries. The chief manufactures are flour, lumber, brick, glass ware, foundry products, mining tools, structural iron, and oil well supplies. The principal public buildings are the churches, schools, and Masonic Temple. Pop. (1910) 5,903.

Rochester Theological Seminary, founded at Rochester in 1850 by the New York Baptist Union for Ministerial Education. As early as 1847 an attempt was made to remove Madison (now Colgate) University from Hamilton to Rochester, but this was opposed by the Baptists of Hamilton and legal obstacles were found, so that the plan was abandoned. The University of Rochester (q.v.) was established at the same time by the Baptists, and for a time the two institutions occupied the same buildings, but there has never been any organic connection between the university and the seminary, the latter being essentially a professional school. The regular course is three years; instruction is given in the departments of Hebrew language and literature (Old Testament), theology, church history, New Testament, homiletics and pastoral theology, elocution, English Bible, and Christian ethics. Graduation from college or preparation in Greek sufficient for the study of the Greek Testament is required for admission; formerly there was an English course for those who had no classical training; this was abandoned in 1889-90. In 1852 a German department was organized; the course is literary as well as theological, and covers six years. The seminary was at first without endowment, and at the end of 10 years had only \$75,000; in 1910 the productive funds amounted to \$1,631,000. The library is one of value, including the whole collection of Neander, the German church historian, and numbering 37,500 volumes. The total number of students including the German department was 167 in 1910.

Rochester, University of. See UNIVERSITY OF ROCHESTER.

Roch'et, the name given a lawn or lace garment, somewhat like the surplice in shape, but with close-fitting sleeves, worn by bishops, abbots, prelates, and other ecclesiastical dignitaries.

Rochette, Désiré Raoul, dā-zē-rā rā-ool rō-shēt, French archæologist: b. Saint-Armand, France, 9 March 1790; d. Paris, France, 3 July 1854. He was educated at Bourges, removed to Paris in 1811, in 1815 became assistant professor to Guizot, whom he afterward succeeded in the chair of history at the Sorbonne. In 1826 he became professor of archæology at Paris, and in 1838 was elected permanent secretary of the Academy of Fine Arts. He gained a wide reputation for learning, was popular as a lecturer, and enjoyed high favor after the Restoration. Besides his unfinished history of ancient art he wrote 'Antiquités du Bosphore Cimmerien' (1822); 'Tableau des Catacombs du Rome' (1837); 'Lettres archéologiques sur la Peinture des Grecs' (1840); 'Mémoire sur l'Acropole d'Athènes' (1845); 'Mémoires d'Archéologie comparée, Asiatique, Grecque, et Etrusque' (incomplete, 1848); etc.

Rock-Bass. See BASS.

Rock-Brake. See FERNS AND FERN-ALLIES.

Rock Crystal. See QUARTZ.

Rock Dove, or Rock Pigeon. See PIGEON.

Rock Drills. The steam or rock drill is known to-day as an American invention and its inception dates back to the excavation of the Hoosac Tunnel in Massachusetts. This enterprise was fathered during its period of construction by the State of Massachusetts and was beset with enormous difficulties. To commence the excavation of a tunnel five miles long through hard rock, and to do the drilling by hand, was an audacious proposition. Still this was undertaken by the State of Massachusetts. In those days of inexperience, many methods of excavation were proposed and tried. Machines were built, tested and condemned. Among the inventors, the man who schemed the machine which in general features embodied the requirements of a perforator for making holes for blasting, was Mr. Fowle, of Boston. He constructed the first machine in which the drill used was made the extension of the piston rod of a reciprocating steam engine, which was moved forward toward the rock as the drilling advanced. The drill had a slow rotary as well as a reciprocating motion to insure the boring of a round hole. With this beginning, machines were improved in details, but operated without notable economy. The drills were heavy and could be used practically only when mounted on heavy carriages running on wheels on a track. They were much too heavy for mine or quarry work, although a few were used for such purposes.

Later came a demand for a lighter machine, and the Little Giant and Eclipse machines, both built by the Ingersoll-Rand Company, of New York, were found useful. The Little Giant was operated by a positive motion valve, and the Eclipse by a piston valve. With the introduction of light drills came various improvements which were found to be invaluable as the scope for the use of the rock drill enlarged. In fact, almost a new drill was made when the

machines were applied on a large scale in New York city for outside excavation at a tunnel under 42d street and under Hell Gate, and also in the hard ore mines of Lake Superior.

As soon as the rock drill attained a reasonable state of perfection, its improvement was immediately manifested to the world at large. It has often been called the advance agent of civilization, and it undoubtedly has a better claim to that title than any other mechanical invention of recent date. All modern engineering is dependent on its use, and problems which would be impracticable without this machine are rendered easy. Its influence on mining, quarrying, railroading and navigation has been felt all over the world. The rock drill has developed the mines of South Africa; and such modern engineering feats as the Hoosac and Mount Saint Gothard Tunnels, Hell Gate, Niagara Tunnel, the tunnel under Bergen Hill and the Palisades, the Croton aqueduct and the Chicago drainage canal were carried to success by rock drills. The work done by the rock drill may be said to be from 60 to 150 lineal feet of hole drilled per day of 10 hours in ordinary stone, including shifting and setting up of the drill, cleaning holes, etc. In tests and special cases the figures have been largely exceeded, sometimes as much as 400 lineal feet being made. Records of 24 inches per minute are not uncommon, all, of course, for down holes in favorable rock, but 70 feet per day of 10 hours in granite, including moving and setting up, averages a fair working basis. The cost of drilling in this way may be stated to vary from 2½ to 13 cents per lineal foot, according to local conditions. From four to five cents per foot of hole drilled may be taken as the working figure for general calculations, and this includes all expenses. Compared with hand methods, the cost of which runs from 25 to 70 cents per foot, with an average of 40 to 65 cents per foot of hole in hard rock, this shows that a given amount of drilling may be accomplished by the rock drill for from 1/6 to 1/12 the cost of doing it by hand. There are two distinct methods of machine drilling, one the auger drill, which bores the rock, and the other the percussion drill, such as the Little Giant or Eclipse, working by direct impact, that is, by striking repeatedly in the same spot and by simply bruising or chipping away the rock. Experience has proved that a reciprocating drill operates with the greatest economy and efficiency. The following are improvements made in the rock drill as used to-day.

Commencing with the cylinder of the drill, the method of using long bolts to hold the top and bottom heads in place with an elastic or spring buffer, whereby the blow (struck accidentally upon either head by the piston) is absorbed, may be placed first. The method of gripping the steel and the chuck by means of the "U" bolt and chuck key stands second. The device of flanged and rotating bar dropped through the ratchet box marked a great advance in the art. The use of the taper throttle was also a very neat device for preventing leakage and providing a graduated admission of the working fluid. In passing from the cylinder to its mounting the most important achievement was in the very simple device of mounting the drill on the horizontal arm attached to a vertical column, which in turn was

ROCK EXCAVATING MACHINERY

mounted to a block and jacked in place by two screws, one on either end of the block. A kindred invention was the universal joint applied to the legs of a tripod.

The requirements of a perfect rock drill are numerous, but it should first of all be simple in construction and strong in every part. The parts as far as possible should be so arranged that any broken or worn portion may be easily removed and a new part substituted, causing the least possible delay in the work. The drill should occupy but little space and should be light enough for easily handling. The mountings on which it is set for different kinds of work should be easily put up and easily removed, insuring a great range of adjustability. It must, of course, be economical in its use of the driving fluid and must put down a hole in the shortest possible time.

Surface and Underground Work.—Surface work includes that class of excavation which occurs in open air, and underground operations include such borings as are underground. Surface drilling may be applied for opening up canals, for quarrying purposes, for opening up ways for railroads and similar undertakings. Such work may necessitate the use of tripod, column and shaft bar, quarrying machines, channelers, gadders and the like. Underground work necessitates the use of rock drills and compressed air machinery for purposes of sinking shafts, opening mines, etc. In shaft sinking and tunnel work, as in driving headings and enlarging, it has been found that the column is the best means of mounting rock drills. These columns are simply round, extra heavy, wrought steel tubes with a suitable claw-foot or rosette on one end and either one or two clamping or jack screws on the other. Stopping bars and tripods are also extensively used for special features.

Submarine Work.—Submarine or subaqueous rock excavation is essential for converting shallow rivers and harbors into navigable waterways. The conditions under which submarine rock excavation must be done are difficult to the last degree, calling for special apparatus of unusual strength and endurance. This character of work is nearly always carried on where tides, currents, winds and storms are present in a varying degree, and these elements are practical obstacles to rapid and economical work. But add to these troubles deep water, irregular bottom covered over with mud, sand and other shifting material, which fills in almost as fast as removed, and the undertaking is seen to be extremely difficult. In the early days, the usual method was to lower explosives to the surface of the rock and attempt fracturing by surface blasting. Later a form of drop bore was introduced by means of which holes were drilled and charges inserted as is at present done. Still another form consisted of a very heavy cast iron bar tipped with a sharp steel point, which was raised and allowed to drop. In operation the sharp point strikes the rock and is supposed to break off a certain amount with each blow. This system is used to some extent abroad, even to-day, but in America it has been abandoned entirely for the more progressive method of drilling a hole and inserting the charge of explosive the same as is done in rock excavation on land.

The removal of submarine rock is daily

becoming a more important feature owing to the increasing depth of ocean and lake-going vessels demanding deeper channels for harbors and rivers. A barge, scow or float fitted with a suitable frame to support the drill guides, drill, boilers and other auxiliary apparatus, is usually employed in submarine excavation. The barge is towed into place and anchored by means of cables, anchor chains or spuds, or a combination of these methods, depending upon the rise and fall of the tide, or the currents to be encountered. The form of framework depends largely upon the system used to feed the drills down, as the hole is cut into the rock. The height of the frame and the length of feed depend on the rise of tide and the depth of water over the rock and the depth to which the hole is to be drilled.

Various styles of mountings are employed in submarine excavation work. The drills used for such operations are generally of the heaviest type, as the work to be done is always severe and difficult. EDWARD F. SCHAEFER, M.M.E.,
Ingersoll-Rand Company, New York.

Rock Excavating Machinery. In quarrying the most important machines are the channeler, the gadder, rock drill, air compressor, etc. To meet the varying requirements of different classes of work four styles of track channelers are manufactured.

Upright Channeler.—This consists of a truck mounted on four flanged wheels running on a track. Upon this truck is carried a boiler, (in the steam driven machine) or a reheater (in the air driven channeler) together with a powerful chopping engine mounted at one side on a frame of great strength. At the end of the piston rod of this engine are connected cutting steels which are driven against the rock by steam or air power in the engine cylinder.

Swing Back Track Channelers.—In machines of this type, the frame carrying the cutting engine swings on a hinge joint, giving an angular adjustment up to 45 degrees from the vertical in the bare machine, or 15 degrees in the outfit carrying the boiler or reheater. In addition to this movement the cutting engine swings in the plane of the frame, with an angular range up to 45 degrees either side of the vertical.

Under Cutting Chambers consist of a heavy frame of cast iron mounted on four wheels, carried on steel axles running in babbitted boxes. At either end of the frame is a special guide shell provided with a swinging adjustment in both horizontal and vertical planes by means of which all angular conditions may be met, and cuts carried clear into the corners. The shells are hung very low, thus giving the least possible offset in cutting. The use of the two shells permits the channeler to work close to the wall and adapts the machine to deposits of any angle or dip.

The *bar channeler* consists of a carriage supporting the cutting engine mounted on two parallel bars along which it is moved automatically by means of a three cylinder engine actuating a traveling feed nut. The engine is automatically reversed at each end of the travel; or the stops may be set at any intermediate point.

The *quarry bar* consists essentially of the

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single bar mounted on four tripod legs, two on either end. On the bar is mounted a carriage which supports the drill and which may be moved along the bar by means of ratchet and pinion and operated by a hand wheel.

The *gadder* consists of a heavy solid cast iron body mounted on four wheels forming a truck running close to the floor of the quarry. To one end of the truck is hinged a standard or arm which can be swung from nearly horizontal to vertical and firmly locked in any desired position. On the swinging arm or standard is a sliding carriage on which may be mounted by means of a cone pivot and bolt, any one of several sizes of rock drills, according to the work to be done. To raise or lower the drill and move it along the slide a chain is attached to the saddle and run up and over a shaft at the end of the swinging arm and down to a small drum on which it is wound by turning a crank conveniently placed for the operator. A special taper gib or wedge clamp is fitted on the saddle, wherewith the saddle is firmly locked to the swinging arm by simply throwing down a small lever when the drill has been raised or lowered to the proper position. At each corner of the truck frame is a large pointed steel pin or pointer, slipping freely in a guide socket and when the machine is properly arranged a blow from a sledge on each of these pins anchors the truck in place.

See AIR COMPRESSORS; ROCK DRILLS; PUMPS, COMPRESSED AIR; PNEUMATIC TOOLS; MINING AND MILLING MACHINERY; COAL MINING MACHINERY; CRUSHING AND GRINDING MACHINERY; TOOLS AND TOOL-MAKING; ETC.

Rock Falls, Ill., city in Whiteside County; on Rock River and on the Chicago, Burlington & Quincy railroad; across the river from Sterling, where connection is made with the Chicago & Northwestern railroad; about 110 miles west of Chicago. It was settled in 1867 by Augustus P. Smith. It is the commercial and industrial centre of the eastern part of the county south of Rock River. The water power is good; the chief manufactures are wire fencing, rivets, agricultural implements, butter tubs, flour, furniture, wooden-ware, wagons, carriages, and dairy products. The number of employees is about 1,000. There are seven churches, a high school, elementary schools, and a public library. The government is vested in a mayor and a council of six members, who serve two years; three members are elected annually. Pop. (est.) 2,200.

Rock Fever. See MALTA FEVER.

Rock-fish, the name of several fishes usually found about reefs and on rocky bottom. In the United States the most prominent one is the striped or rock bass (see BASS); another is a grouper (*Epinephelus adscensionis*) of the West Indies, called by English-speaking fishermen "rock-hind." The name applies on the Pacific coast to the whole family *Scorpenidae*, represented in the Atlantic by the dory or rose-fish (*Sebastes marinus*), which looks somewhat like a perch in form, reaches a length of two feet, has a rosy hue, and is excellent for the table; it may be known by its nearly uniform orange-red color, and its spiny head. The genus *Sebastes* contains more than 50 species of

Pacific coast rockfish, and several are constantly brought to market. Says Jordan: "*Sebastes pauci spinus*, the bocaccio, large and swift, is abundant in California. *Sebastes flavidus*, the yellow-tail rockfish, reaching a length of two feet, is one of the most valuable species. It is abundant from San Francisco to San Diego. *S. mystinus*, the black rockfish, is the most abundant species in rather shallow water about San Francisco. Another abundant species is the orange rockfish, *S. pinniger*, found from Puget Sound to San Diego. It reaches two feet in length, and is a common market fish; and the rasher (*S. miniatus*) is another important species, reaching a length of two feet and abundant from San Francisco to San Diego. The red rockfish (*S. ruberrimus*) is the largest species of all, reaching a length of 2½ feet; it is abundant from San Diego to Puget Sound, and is a valued food fish. Another important species is the yellow-backed rockfish (*S. maliger*), which is found from Monterey to Sitka. It is especially abundant northward, and reaches nearly two feet in length. The Spanish flag, *Sebastes rubrivinctus*, banded red and white, is perhaps the handsomest sea fish in our waters." Consult Jordan and Evermann, 'American Food and Game Fishes' (1902).

Rock Hind. See ROCK-FISH.

Rock-hopper, a rock wallaby or kangaroo (q.v.).

Rock Island, Ill., city, county-seat of Rock Island County; on the Mississippi River, and on the Chicago, R. I. & P., the Chicago, B. & Q., and the Chicago, M. & St. P. R.R.'s; 180 miles west by south of Chicago, opposite Davenport (q.v.); Iowa, a few miles below Moline (q.v.), and 125 miles, in direct line, north by west of Springfield, the State capital. The city is named after the island in the river between the cities of Rock Island and Davenport. The United States government and the Chicago, Rock Island & Pacific railroad built a combined railroad and highway bridge from Rock Island city to the island and thence to Davenport. The original cost of this bridge was \$1,000,000. Another bridge connects Moline with the island, thus making the three cities ("The Triplets"); one in many matters commercial and industrial. Rock Island has steamer connections with all the Mississippi ports. The island is three miles long, composed largely of limestone. A government arsenal and armory are on the island. That portion of the river between the island and Davenport is navigable, but on the west side of the island the river has been dammed by the United States government, thus furnishing Rock Island, Moline, the island, and Milan (a few miles below the city) with extensive water-power, which has contributed to the development here of a large and important manufacturing centre. Rock Island has excellent transportation facilities which make it of importance as a commercial city.

The chief industrial establishments are the arsenal, in which there are 2,000 employees; plow factory, which has 800 employees; lumber mills, 1,000 employees; railroad employees 500; brewery, 150 employees; oil-cloth factory, 150 employees, and a number of smaller industries which give employment to some hundreds of persons. The prominent public buildings are the

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government arsenal, with \$10,000,000 of improvements; the court-house, which cost \$175,000; the high school, \$125,000; the library, \$75,000; Saint Anthony's Hospital; the 20 churches, and a number of fine business blocks. The Davenport mansion, on the island, is of historic interest. The educational institutions are Augustana College (Lutheran), opened in 1860, Villa de Chantal (Sisters of the Visitation), public and parish schools, several private schools, one city library, and three school libraries. The five banks have a combined capital of \$400,000. The government is vested in a mayor and a council of 14 members, each elected for a term of two years.

Rock Island was settled in 1826 by Colonel George Davenport. It was platted in 1835, and called Stephenson. In 1841 it was united with Farnhamesburgh under its present name, and in 1849 was chartered as a city. When Colonel Davenport built his home on the island, in 1833, the neighboring places were a fort and an Indian trading post. Prior to his settling in this locality, in 1826, he had been there in 1816 with the government troops, when Fort Armstrong was established. Black Hawk, the Indian chief, often visited him here, and many of the people who are now regarded as "history makers" often visited Davenport in his island home. During the Civil War, the prison here was the place of detention of many Confederate prisoners. When the Mississippi Valley began to change from a raw producing region to a section sending to the world the finished and polished product of the best in manufacturing methods, Rock Island was among the leading cities which were quick to welcome the railroad and the manufactory, and the first to use the improved means presented to extend the commerce of the city. Pop. (1880) 11,659; (1890) 13,634; (1900) 19,493; (1910) 24,335.

H. P. SIMPSON,
Editor 'Rock Island Argus.'

Rock Kangaroo or Wallaby. See KANGAROO.

Rock-melon. See MELONS.

Rock Ptarmigan. See PTARMIGAN.

Rock-rabbit. See HYRAX.

Rock Rapids, Iowa, town, county-seat of Lyon County; on the Rock River, and on the Illinois C., the Burlington, C. R. & N., and the Chicago, St. P., M. & O. R.R.'s; about 58 miles north of Sioux City. It is in an agricultural and stock-raising region. It has considerable manufacturing interests connected chiefly with farm and dairy products. It is the commercial centre of a large part of the county. Pop. (1910) 2,000.

Rock River rises in the State of Wisconsin, 50 miles west of Lake Michigan; it flows south-southwest, receives several tributaries, enters Illinois, and crossing the State in a south-westerly direction, flows into the Mississippi a little below Rock Island. Its whole length is estimated at 330 miles, about 225 of which have been ascended by small steamers, though with some difficulty, owing to the various rapids. The region which it drains is one of great fertility.

Rock-roses. See CISTUS.

Rock Salt. See SALT.

Rock-snake, a name among English colonists for pythons generally; especially for *Python regius* of southeast Africa, which sometimes grows to a length of 15 feet.

Rock-soap, a hydrated silicate of aluminum, containing peroxide of iron and water. It is a variety of halloysite, is found only massive, is earthy, easily broken, black or nearly so, very soft, somewhat greasy to the touch, and adheres strongly to the tongue. Rock-soap is used for crayons, and is also useful, by reason of its saponaceous properties, in the washing of cloths, etc.

Rock Springs, Wyo., in Sweetwater County; on Bitter Creek, and on the Union Pacific railroad; about 250 miles west of Laramie. It is on a plateau, in a mountainous region in which there are extensive coal fields. The principal industries are connected with the mining and shipping coal. There are two banks, which have a combined capital of \$125,000. The educational institutions are a public high school, public and parish elementary schools, and a high school library. Pop. (1880) 763; (1890) 3,406; (1900) 4,363; (1910) 5,778.

Rock-temples. In many parts of western India, as at Ellora, Elephanta, Karli, and Salsette Island, natural rocks have been cut into temples; as also into caves and forts. Out of India well-known instances of the same kind occur at Petra, in the Arabian Desert, at Abu-Simbel, in Egypt, and in China and Siam. See also CAVE-DWELLERS.

Rock-trout, a valuable fish (*Hexagrammus decagrammus*) of the coast of California and northward. It is one of the greenlings (q.v.), and is known northward as boregat and bodieron. It reaches a length of 18 inches, and is regarded as an excellent food-fish.

Rock-work. See MASONRY.

Rock-wren, a grayish-brown migratory wren (*Salpinctes obsoletus*) of the Rocky Mountain region which haunts the mountain gulches and makes a big rough nest in some rift of rock, or on a ledge. It has a charming song, and is likely to come familiarly about the mountaineer's cabin. Consult Coues, 'Birds of the Southwest' (1878).

Rock'all Islet, in the North Atlantic Ocean, 160 miles west of Saint Kilda, 260 miles north of Ireland, and 290 miles west of the mainland of Scotland, is an isolated conical rock of stratified granite, 100 yards in circumference, rising 70 feet above the sea, from a sandbank about 50 miles long and 25 miles broad. The vicinity is a cod-fishing ground for Scotch and English fishermen. The first known landing was made in 1810, and the islet was the object of a scientific expedition in 1896.

Rockefeller, rök'e-fël-ër, John Davison, American capitalist: b. Richford, Tioga County, N. Y., 8 July 1839. After an education in the public schools of Cleveland, he there entered a mercantile establishment as clerk, and subsequently was made cashier and bookkeeper. In 1858 he became a member of the firm of Clark & Rockefeller, and in 1860 the concern entered the oil business as Andrews, Clark & Company. The firm, its style having been changed to William Rockefeller & Company, built the

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Standard oil works at Cleveland in 1865, and in 1867 the various interests with which John and his brother William were connected were consolidated into one corporation. In 1870 the Standard Oil Company was incorporated, with John Rockefeller as president. Increasing business led to the formation in 1881 of the Standard oil trust, which, however, was dissolved in 1892. Since that time Rockefeller has continued in control of the various separate companies in which he is the principal stockholder. His chief gifts have been to the University of Chicago; these, unconditional and conditional, aggregating more than \$20,000,000. He presented also to Cleveland real estate and cash to the value of \$900,000; to Vassar College a \$100,000 building and 3,000 volumes on Greek art and literature; to Tarrytown, N. Y., \$50,000 for a high-service water tower; to the American Baptist Missionary Union, \$400,000; and to Barnard College, \$1,375,000; to the General Education Board (total) \$43,000,000; etc.

Rocket, the name of several plants; one salad plant, chiefly used by Italians, is the *Brassica eruca*; the yellow rocket is the common winter cress, *Barbarea vulgaris*; but the sweet or dame's rocket is the most widely known. It is a tall perennial, with purplish or white single flowers in a loose raceme, and fragrant at night, much used in old-fashioned gardens.

Rockets. See PROJECTILES.

Rockford, rök'förd, Ill., city, county-seat of Winnebago County; on the Rock River, and on the Chicago & N. W., the Chicago, M. & St. P., Chicago, B. & Q., and the Illinois Central R.R.'s; 81 miles northwest of Chicago. It was settled in 1834, being the first settlement in the county; and was incorporated as a city in 1853. In 1890, it obtained a considerable increase of territory by annexation. It is built on both sides of the river, which is here crossed by three railroad and three highway bridges. A dam 800 feet long across the river secures excellent water power for manufacturing, and the city is one of the most important industrial centres of northern Illinois. The chief manufactures are agricultural implements and furniture; others are pumps, watches, silver-plated ware, knitting wool, paper, flour, and grape sugar. According to the census of 1900 the manufacturing establishments numbered 450, with a capital of \$14,126,834; in 1904 the number of employees was about 13,000. There are six banks with a combined capital of \$650,000, doing an annual business to the amount of \$22,969,727.53 (clearing-house, 1903). Rockford is surrounded by a fertile agricultural region, and with its railroad facilities is an important shipping point for the products of this district. The city is well built with wide, regular streets; among its notable public buildings are the Memorial Hall for Soldiers, the city-hall, the court-house, two hospitals and the public library; the library contains over 20,000 volumes. The public school system is of the best, and includes a high school, organized in 1857; there is also a Roman Catholic parish school; and the city is the seat of Rockford College (for women) and of Brown's Rockford Business College. The government is vested in a mayor and a council of 15, elected

biennially; the council has the power of appointing the city officers. There is an excellent water supply from five artesian wells, and the waterworks are owned and operated by the municipality. Pop. (1900) 31,051; (1910) 45,401. Consult C. A. Church, 'History of Rockford and Winnebago County, Illinois' (1900).

J. STANLEY BROWNE,
Editor 'Morning Star.'

Rockford College, a college for women, located at Rockford, Ill. It was founded in 1849 as a seminary, and received its college charter in 1892. It has a collegiate department, department of music, and preparatory department; the collegiate work is in two courses, classical and general scientific, for the completion of which the degrees of A.B. and B.S. are conferred. In 1910 the ground and buildings were valued at \$150,000; the productive funds amounted to \$147,000, and the annual income to \$61,000. In 1910 the students numbered 174, and the instructors 27.

Rockhampton, rök-hämp'ton, Australia, capital of the county of Livingstone, Queensland, on the Fitzroy River, about 420 miles by rail northwest of Brisbane, almost on the Tropic of Capricorn. It is enclosed by hills, and is the gateway to rich pasture lands, and the adjacent Mount Morgan mineral fields. It has considerable river traffic with the ports of Alma and Broadmount at the mouth of the river, 35 miles distant.

Rock'hill, William Woodville, American diplomatist: b. Philadelphia 1 April 1854. He was educated at the Lycée Bonaparte and the Collège de France, Paris, and was graduated from the military school of Saint Cyr in 1871. He served with a French regiment in Algeria but returned to the United States in 1876. In 1881 he returned to France and resumed his oriental studies begun during his college course, and in 1884 entered the diplomatic service as 2d secretary of legation at Peking, China. He was *chargé d'affaires* at Seoul, Korea, 1887-8; visited China, Mongolia and Tibet during 1888-92 on exploring tours; was appointed chief clerk of the State Department in 1893; was made 3d assistant secretary of state a year later; and 1st assistant in 1896. He was minister to Greece, Rumania, and Serbia, 1897-9, and the following year went as United States commissioner to China, where in 1901, under appointment as special ambassador, he signed the final peace negotiation. In October 1901 he resumed his duties as director of the Bureau of American Republics to which he was appointed in 1890. He has published 'Udanavarga, the Northern Buddhist' (1883); 'A Life of Buddha, and the Early History of his Church' (1884); 'Land of the Lamas' (1891); 'Diary of a Journey in Mongolia and Thibet' (1893).

Rockhill, S. C., town in York County; on the Southern and the South Carolina & G. E. R.R.'s; about 25 miles south-southwest of Charlotte, N. C. It is in a fertile agricultural region in which cotton is one of the principal products. The principal industries are connected with cotton and farm products and lumber. ... Normal College, with about 500 students, is located here. The bank;

ROCKING STONE—ROCKLAND

have a combined capital of \$150,000. Pop. (1910) 7,216.

Rocking Stone, or **Loggan-stone**, a block of stone, or a mass of rock, often of great size and weight, so nicely poised on a lower mass that it can be moved backward and forward with but little force. Some rocking stones are evidently artificial, others natural. The former appear to have been contrived by cutting out a mass of rock round the centre-point of the base of the block. The latter are generally granitic rocks, in which porphyry and feldspar are abundantly found. These ingredients being rapidly decomposed, and the sand and dust swept away by wind and rain, what was originally a solid rock becomes a group of pillars of irregular shape, separated by horizontal and vertical fissures. Gradually the edges of the block forming the pillar decay, and it assumes the appearance of two or more spheroidal rocks, one resting on the other. When the upper mass is so situated as to preserve its equilibrium notwithstanding the gradual wearing away of the base, a rocking stone is the result. Rocking stones occur in nearly all countries. In Great Britain they are found in Cornwall, Derbyshire, Lancashire, Yorkshire, and Wales, in the shires of Perth and Kirkcudbright, Scotland, and also in many places in Ireland. Much larger than any of these, however, is the rocking stone of Tandil in Argentina, 250 miles south of Buenos Ayres, which weighs over 700 tons, yet is so poised that it rocks in the wind and may be made to crack a walnut. Rocking stones are supposed to have been employed in ancient times for purposes of divination, the favorable or unfavorable oracle being determined by the number of vibrations. Consult Vincent, 'Around and About South America' (1890).

Rockingham, rōk'ing-am, **Charles Watson-Wentworth**, MARQUIS OF, English statesman: b. 13 May 1730; d. 1 July 1782. He was educated at Westminster School and Saint John's College, Cambridge, and in 1750 was created an Irish peer under the titles of Baron and Earl of Malton, later in the same year becoming also an English peer and Marquis of Rockingham by succession. He took his seat in the House of Lords in the following year and continued in practice with his Whig sympathies which he had inherited from his father. He took little part in politics, being a hesitating speaker and of mediocre talent, until 1765 when on the refusal of Pitt to take office, he became prime minister. His large wealth and powerful family position contributed to his elevation, and he had the invaluable assistance of his brilliant secretary, Edmund Burke. He took a friendly attitude toward the American colonies and favored the repeal of the Stamp Act, though he affirmed the right of Parliament to tax the colonies. He gave offense to the king for his support of the repeal principle and for refusal of allowances to the king's brothers, and was superseded by Pitt who returned to form a new ministry. His tenure lasted barely a year and his parliamentary career was inconspicuous until March 1782 when upon the fall of North's administration he was called upon to form a coalition ministry in which he held the treasury. The chief

events of his second term were the concession of legislative independence to Ireland, and the forcing the king to treat for peace with the United States on the basis of their independence. In accomplishing these ends credit is not given to Rockingham for enlightened statesmanship but rather for the adoption of a policy of opportunism. Consult Albemarle, 'Memoirs of Rockingham' (1852-3).

Rockland, Maine, city, and county-seat of Knox County. Set off from Thomaston in 1848, and incorporated a city in 1854. On a harbor which is an easterly extension of Penobscot Bay at its mouth; is very commodious and easily accessible; is naturally protected from storms coming from any direction except from the northeast and against these by a breakwater a little more than four-fifths of a mile long extending from the northern shore, and is marked by two lights, a revolving one at the extremity of the breakwater and a fixed one at Owl's Head, the promontory in which its southerly shore ends. The breakwater was begun by the U. S. Government in 1881, and practically completed in 1902. It cost about \$500,000. Rockland is connected with Maine Central R. R. system; 86 miles by rail from Portland; has steamboat connection with Boston, Bangor and Portland, and with all the important coast and island towns of eastern Maine as far east as Machias, a steamer running every day to and from Bar Harbor during most of the year. It is the centre and managing point of the Rockland, Thomaston & Camden Street Railway system, which has 21 miles of track extending northward to Rockport and Camden, and westward to Thomaston and Warren, and other electric railways. The region thus connected accommodates many summer tourists and visitors. Many wealthy people have built summer cottages at Camden, which place is especially notable for its combination of coast and mountain scenery. Within its limits are several mountain peaks varying in height from 1,000 to 1,500 feet. Mt. Battie is close to Camden Village and very near the shore, and Mt. Megunticook, a loftier peak, extends along the shore further north. Along the inner side of these two mountains a road has been cut, which extends along the shore of a large lake, and affords some grand and beautiful scenery. The lake furnishes water power for extensive manufactories, the water being used five times in the descent of little more than two miles from the lake to where it flows into the salt water at Camden Harbor. Norumbega, a fine stone house built by the late J. B. Stearns, the inventor of the duplex telegraph, is one of the handsomest private residences ever constructed in Maine.

Industries.—Shipbuilding has been for many years an important industry in this section, and fine vessels are constructed at Thomaston, Rockland, Rockport and Camden. A large part of the accumulated wealth has been derived from the building and operation of vessels. The Red Jacket, a clipper ship built at Rockland in 1853, is said to have made the passage across the Atlantic Ocean in a shorter time than it was ever made by any other sailing vessel. The principal industry of Rockland from a period that goes well back toward its settlement has

ROCKLAND — ROCKPORT

been the manufacture of lime. This is also carried on at Rockport and Thomaston. The Rockland limestone has a higher percentage of calcium than any other considerable deposit in the country, and is reputed in the building market to make the strongest mortar. The quality and quantity have been materially improved by the introduction of patent kilns, in 1850, and the more recent introduction of coal as fuel. In 1890 a steam railroad was constructed to transport the stone from the quarries in the rear of the town to the kilns on the water front. Formerly in the hands of independent operators, the industry passed over to the Rockland-Rockport Lime Co., which now controls the railroad and about three-fourths of the product. The company also operates a large factory for the manufacture of hydrated lime. The shipments to New York and other points are largely made in barges towed by tugs. The granite business is important. Two of the largest granite companies of the country have quarries in the vicinity, on the islands and on the mainland. These companies have handled some of the largest stones that have ever been wrought. The United States custom house in St. Louis, the postoffices in New York and Cincinnati, and many of the largest and handsomest buildings in the country have been built of Rockland granite. Steam and gasoline engines and blacksmiths' and granite workers' tools are manufactured. Fishing is carried on to some extent. Clams and sardines are canned, and more than 2,000,000 pounds of lobsters are shipped annually from here by rail. It is an important distributing point to the towns of eastern Maine.

The public buildings are the U. S. custom house and postoffice building, which is a handsome granite structure and cost about \$150,000, and the County court house and jail, which are of brick with granite trimmings and are on the same lot. The two cost something more than \$100,000. There are many handsome residences with fine grounds. In one of the cemeteries is a statue of white Italian marble of General Hiram G. Berry, who was a citizen of Rockland, and was killed at the Battle of Chancellorsville. It is the work of Franklin Simmons. Pop. (1910) 8,174.

LEWIS FREDERICK STARRETT.

Rockland, Mass., town in Plymouth County; on the New York, New Haven and Hartford railway; about 17 miles south by east of Boston. Until its incorporation as a separate town in 1874, it was a part of the town of Abington of the old Plymouth Colony. The town is pleasantly situated and its proximity to Boston and the convenience of transportation, give it an excellent trade and have made it a popular suburb of that city.

Rockland is a manufacturing place of growing importance. The census of 1900 returned 81 establishments with a combined capital of \$998,824, employing 1,071 persons at \$515,974 in annual wages. They used \$1,363,959 in materials and had a product valued at \$2,288,972. The industry first in importance was the manufacture of boots and shoes. Tacks are also extensively manufactured; and other factories

produce heels and shoe-findings, box board, shoe boxes, and soaps.

Rockland has well-built factory and public buildings, churches, schools, and attractive homes. It has two banks, a public library, and weekly newspapers. Pop. (1890) 5,213; (1900) 8,150; (1910) 6,928.

Rockland, N. Y., a county in the southeastern part, bordering on New Jersey, and bounded on the east by the broadened expanse of the Hudson River known as the Tappan Zee and Haverstraw Bay. Nyack (q.v.), its largest town, is about 30 miles from New York, and in the vicinity, which is near the northern end of the Palisades of the Hudson and rugged and picturesque, are many handsome estates of New York business men. The county-seat is New City. The county is served by the New York, L. E. & W., the New Jersey & N. Y., and the West Shore R.R.'s; and while in many parts the soil is rocky, has, particularly in the eastern part, rich farms and large dairy interests. In the western section are the Ramapo Mountains, which contain the sources of the Ramapo and Hackensack Rivers. Granite, gneiss, limestone, trap, and red sandstone are extensively quarried, the last a good building-stone; the brick manufacturing industries are important; and large quantities of fruit, green vegetables, butter, and milk are shipped daily to New York. Many of the farmers "take boarders" during the summer months, and its healthfulness and its proximity to the city make Rockland County a popular vacation resort.

Rockland Lake, N. Y., a village of Rockland County, on the West Shore Railway, and on the Hudson River; four miles above Nyack and 30 miles above New York. It has only a small permanent population but is a popular vacation resort. Near here is Rockland Lake, a large sheet of clear, fresh water, from which 300,000 tons of ice are taken annually for use in New York.

Rockling, a European fish of the cod family and of the genus *Motella*, three species of which are regarded as valuable in British markets.

Rockport, rôk'pôrt, Ind., city, county-seat of Spencer County; on the Ohio River, and on the Louisville, E. & St. L. railroad; about 100 miles southwest of Louisville, Ky., and 30 miles in direct line east by south of Evansville. It has steamer connections with all the river ports. It is on a bluff about 100 feet above high water. It is in an agricultural region in which grain and tobacco are the chief productions. The city has considerable manufacturing interests; the principal industrial establishments are flour and grist mills, foundry, machine shops, tobacco stemmeries, brick works, basket factories, creamery, wagon and carriage works, and furniture factories. It has a library founded in 1855. Pop. (1890) 2,314; (1900) 2,882; (1910 est.) 3,100.

Rockport, Mass., town in Essex County; on the Atlantic Ocean, and on the Boston & M. railroad; about 30 miles northeast of Boston.

ROCKPORT—ROCKS

It is on an island, the same on which Gloucester (q.v.) is located. The town embraces several villages. Electric lines connect Rockport and Gloucester and many points on the island. It was settled in 1690 by Richard Tarr and was known at first by the name "Sandy Bay." It is a famous summer resort; near Pigeon Cove, one of the villages, are a number of summer cottages. Part of the land is fertile and is used mainly for market gardening. Some of the places of interest in the vicinity are Dogtown Commons, where in the last of the 18th century a hundred families exiled themselves and lived in loneliness and poverty on those boulder strewn hills. Their numerous dogs gave the place its name. Other places of interest are Doctor's Run, The Headlands, and the Straits-mouth Life Saving Station at Gap Cove. In the northeastern part of the town are extensive granite quarries. The Boston post-office is built of granite obtained from these quarries. The chief manufacturing establishment is an isinglass factory which employs about 1,000 persons. There is one national and one savings bank. There are 12 churches, and the educational institutions are a high school, grammar and primary schools, and a public library, opened in 1871. Pop. (1910) 4,211.

G. M. HASKINS.

Rockport, Texas, town, county-seat of Aransas County; on the Aransas Bay, an inlet of the Gulf of Mexico, and on the San Antonio & A. P. railroad; about 170 miles southwest of Galveston, and 135 miles south by east of San Antonio. It was settled in 1865 by Doughty and Mathis; was incorporated in 1865 and chartered as a city in 1871. It has steamer connections with all of the Gulf ports. It is on the peninsula, Live Oak Point; and the cool gulf breezes make it a popular summer resort. It has extensive fishing interests, especially oysters, and small game is plentiful in the vicinity. Rockport makes large shipments of hides, live-stock, and fruit. There are five churches, a high school, elementary schools, and one national bank. The government is vested in a mayor and a board of aldermen, eight in number, who are elected biennially. Pop. (1900) 1,153; (1910) 1,297.

C. W. NEWMAN,
Editor 'Enterprise.'

Rocks. Regarded as a whole, the earth, so far as we can examine it first hand and thus know it intimately, consists of three envelopes: (1) an outer gaseous envelope called the atmosphere; (2) a middle aqueous envelope called the hydrosphere; (3) an inner solid envelope called the lithosphere. These envelopes, considered together, including the lithosphere to a depth of 10 miles below the sea-level, have been shown to consist quantitatively of the following elementary substances:

O	49.98%	Na	2.28%	P	0.09%
Si	25.30%	K	2.23%	Mn	0.07%
Al	7.26%	H	0.94%	S	0.04%
Fe	5.08%	Ti	0.30%	Ba	0.03%
Ca	3.51%	C	0.21%	N	0.02%
Mg	2.50%	Cl:Br	0.15%	Cr	0.01%

These 18 substances have been shown by F. W. Clarke (Bulletin 78 United States Geological Survey, pp. 34-43) to comprise the great bulk of the earth. The others, though outnumbering them three to one, can be ignored.

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The above-named elements, so far as they enter into the composition of the lithosphere, rarely occur in the uncombined state, but are usually united chemically in different proportions to form those more or less definite chemical compounds called minerals (for example, quartz, SiO_2 ; calcite, $\text{CaO} \cdot \text{CO}_2$; olivine, $(\text{MgFe})_2\text{SiO}_4$); and minerals in turn are aggregated in various ways to form rocks. A rock may be defined as any accumulation or aggregation of one or more mineral species or substances, potential or actual, which constitutes a considerable component of the lithosphere; for example, granite, sandstone, limestone, clay, gravel, salt-beds. Although the crust of the earth or lithosphere has been shown to contain many hundreds of species of minerals, nevertheless the great bulk of it is composed of comparatively few species, and these have been termed the rock-forming minerals, in contradistinction to the great multitude of mineral species found more particularly in veins, and which, though of great importance economically, and of primary interest scientifically, are insignificant in amount when compared with the great mass of the more common minerals which go to make up a large portion of the earth. Thus gold, silver, platinum, the sulphide ores, and the minerals containing such rare substances as thorium, uranium, or radium, are negligible in quantity when compared with the mass of minerals composing the lithosphere.

The science or treatise of rocks, in its broadest scope, which considers them in all their relations, is called petrology or lithology, while the systematic and descriptive science of rocks, leading more particularly to their nomenclature, is called petrography. This distinction is implied in the etymology of the words. The latter term is used commonly in connection with the microscopic study of the igneous rocks.

Those minerals which are of especial importance as rock-formers can be grouped as follows:

GROUP I.

Quartz.—This group, for present purposes, may be limited to a single species, quartz, which is one of the most abundant of minerals, and is remarkable otherwise for its rather superior hardness, lack of cleavage, and indestructibility. It has strong crystallizing powers and, where allowed to grow intact, forms those beautiful hexagonal crystals with which all are familiar. Chemically it is an oxide of silicon, SiO_2 , that most abundant of all acid radicals, which, when combined with the bases alumina, lime, iron, magnesia, and the alkalies, soda and potash, in different ways, forms that most important of all classes of mineral substances, the silicates.

GROUP II.

Feldspars.—These are the most abundant of all rock-formers. They comprise a rather complex group of silicates, where alumina, the alkalies, potash and soda, and the alkaline earthlime, are the bases. On a chemical and crystallographic basis they fall naturally into two series, the orthoclase and the plagioclase. Orthoclase, so called because of the rectangular cleavages lying parallel to the ortho- and clinopinacoids, is the type-species of the series. It is a silicate of potash and alumina having the chemical composition KAlSi_3O_8 , and is otherwise

ROCKS

known as potash feldspar. It belongs to the monoclinic system of crystallization, and is further known as the monoclinic feldspar. A part of the potash of orthoclase may be replaced by soda. In fact most of the analyses of the mineral show one per cent or more of the substance. This replacement of potash by soda can take place until these two constituents are present in nearly equal proportions without altering the monoclinic character of the species. Such an orthoclase is called soda-orthoclase. Soda-orthoclase has a chemical composition represented by the formula $(\text{Na}, \text{K})\text{AlSi}_3\text{O}_8$, where soda predominates over potash. Under the microscope and between crossed nicols it exhibits a peculiar patchy appearance easily recognized.

Microcline, like soda-orthoclase, contains both potash and soda, $(\text{K}, \text{Na})\text{AlSi}_3\text{O}_8$. It is, however, triclinic, but only slightly so, as the cleavage angle between the pinacoids varies but slightly from 90° ($89^\circ 30'$), hence the name. Between crossed nicols it exhibits a peculiar cross-hatching, due to multiple twinning according to both the pericline and albite laws, and is thus usually easily distinguished under the microscope. It stands at the head of the true plagioclase series, but inasmuch as it possesses a notable amount of potash, it may be classified with soda-orthoclase as representing the transition varieties of feldspar, lying between the monoclinic, potash, orthoclase series and the triclinic, soda-lime, plagioclase series.

The more typical plagioclases are represented by albite, oligoclase, andesine, labradorite, bytownite, and anorthite, which together constitute the albite-anorthite series. The theory of their constitution was propounded by Tschermak in 1864. He showed that the series can best be explained as a mixture of two extreme molecules, the one a pure soda-alumina silicate molecule, and the other a lime-alumina silicate molecule, found in anorthite. The intermediate varieties can be considered as varying mixtures of these two molecules. Representing the albite molecule by Ab and the anorthite molecule by An, the series is expressed thus:

Albite	$\text{Ab}(\text{NaAlSi}_3\text{O}_8)$
Oligoclase	Ab_2An_1 to Ab_1An_2
Andesine	Ab_3An_2 to Ab_2An_3
Labradorite	Ab_4An_1 to Ab_1An_4
Bytownite	Ab_1An_3 to Ab_3An_1
Anorthite	$\text{An}(\text{CaAl}_2\text{Si}_2\text{O}_8)$

This series of mineral varieties furnishes one of the best illustrations of an isomorphous mixture. It constitutes the albite-anorthite or soda-lime series of plagioclase feldspars, all of which are distinctly triclinic. The cleavage angle in this series varies from $93^\circ 31'$ in labradorite to $94^\circ 5'$ in albite.

Usually the plagioclase feldspars can be quickly and surely distinguished from the microcline or the orthoclase varieties by their characteristic multiple twinning, which is manifested in thin sections between crossed nicols by a distinct parallel banding that traverses the individual mineral plates. It thus becomes a comparatively simple matter, with thin sections under the microscope and between crossed nicols, to distinguish between orthoclase, which normally shows plain non-striated plates, soda-orthoclase, which has a peculiar patchy appear-

ance, microcline with its more or less indistinct cross-hatching, and plagioclase with its characteristic, sharply defined, parallel banding. Furthermore, the different varieties of the plagioclase series can be identified by their behavior in polarized light, more particularly by the variation in their extinction angles. In a general way this angle may be said to increase in size in passing from the albite toward the anorthite end of the series.

The feldspars are not only of primary importance as rock-formers, but the classification of rocks as at present accepted (more particularly the igneous varieties) depends largely upon the kind of feldspar which they contain.

The feldspars can be grouped in tabular form thus:

		Cleavage angle
(a) Monoclinic		
Orthoclase	KAlSi_3O_8	90°
Soda-orthoclase	$(\text{Na}, \text{K})\text{AlSi}_3\text{O}_8$	$90^\circ (?)$
(b) Triclinic		
Microcline	$(\text{K}, \text{Na})\text{AlSi}_3\text{O}_8$	$90^\circ 30'$
Soda-microcline	$(\text{Na}, \text{K})\text{AlSi}_3\text{O}_8$	$90^\circ 30'$
Albite	$\text{NaAlSi}_3\text{O}_8 = \text{Ab}$	94°
Oligoclase		$93^\circ 4'$
Andesine		$93^\circ 23'$
Labradorite		$93^\circ 31'$
Bytownite		
Anorthite	$\text{CaAl}_2\text{Si}_2\text{O}_8 = \text{An}$	$93^\circ 13'$

Crystallizing as they do in two systems, the feldspars are said to be dimorphous; and the group may be described as consisting of a series of isodimorphous mixtures of the orthoclase albite and anorthite molecules.

Frequent parallel intergrowths of two varieties of feldspar occur; for example, albite may be intergrown with microcline or orthoclase, where the albite shows as narrow irregular bands of a different-colored mineral matter running across the cleavage surfaces of the orthoclase or microcline. Such intergrowths are called perthitic intergrowths or perthite because certain flesh-red feldspars from Perth, Canada, were first shown to be made up of such intergrowths. These intergrowths are sometimes so minute as only to be made out with the microscope, and then they are called microperthite. Brögger has suggested that certain soda-orthoclases are intergrowths of this kind in which the albite lamellæ are so narrow as not to be discoverable even with the highest powers of the microscope. For these supposed intergrowths he proposes the name cryptoperthite.

Similar parallel intergrowths of distinct mineral species may occur where quartz is intergrown with microcline. Such intergrowths of quartz and feldspar (usually orthoclase or microcline) are common in certain granite-like rocks called pegmatite, and are known as pegmatitic intergrowths, or graphic granite, referring to the resemblance of the curious V-shaped areas of quartz to cuneiform writing.

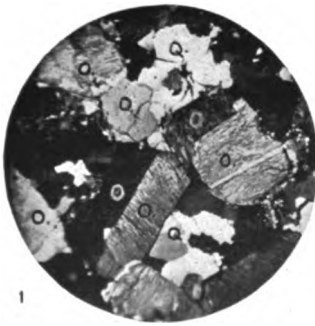
GROUP III.

Feldspathoids.—The minerals of this group are called feldspathoids or feldspar-like minerals, more particularly because of their chemical resemblance to the feldspars. There are but two species which need be considered here: leucite, which has a chemical composition expressed by the formula $\text{KAl}(\text{SiO}_3)_2$; and ne-

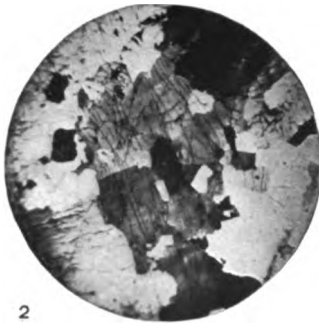
ROCK FORMATIONS

- FIG. 1. Micro-photograph of thin section of granite, from Lokken, Norway, between crossed nichols, showing patchy appearance of soda-orthoclase (O), irregular plates of quartz (Q), and illustrating granitoid (xenomorphic or allotrimorphic) texture. The orthoclase shows twinning.
- FIG. 2. Micro-photograph of thin section of augite-syenite from Laurvik, Norway, between crossed nichols. The photograph shows only plain non-striated orthoclase and illustrates granitoid allotrimorphic or xenomorphic texture. The lines due to cleavage.
- FIG. 3. Micro-photograph of thin section of norite, from Hitteroe, Norway, between crossed nichols, showing banded plagioclase Labradorite (Pl), an opaque ore, ilmenite (I), and a monoclinic pyroxene diallage (D). The section also illustrates granitoid (xenomorphic or allotrimorphic) texture. A fringe of biotite surrounds part of the ore.
- FIG. 4. Micro-photograph of thin section of Perthite, between crossed nichols, showing intergrowth of albite (Ab) and microcline (Mi). The albite shows banding and the microcline cross-hatching.
- FIG. 5. Micro-photograph of thin section of graphic granite from New Bedford, Mass., between crossed nichols, showing parallel intergrowth of quartz (Q) and microcline (Mi). The latter shows cross-hatching.
- FIG. 6. Micro-photograph of thin section of porphyritic perlite showing sanidin crystals (S) in glassy ground mass. Dark wavy bands indicate flow in the mass before cooling (flow structure).
- FIG. 7. Thin section of porphyritic trachite showing sanidin (S) and biotite (B) in glassy ground mass. The crystals have been co-eroded or re-dissolved by the magma as is shown by their even curved boundaries.
- FIG. 8. Micro-photograph of thin section of tinguaita porphyry from the Odenwald showing idiomorphic crystals of nepheline (N), also an indistinct zonal structure in the same.
- FIG. 9. Micro-photograph of thin section of olivine norite, from Risor, Norway, showing long lath-shaped crystals of plagioclase (Pl), augite with characteristic nearly rectangular cleavage (A), olivine altered on the margins to serpentine (Ol), and an opaque ore (M).
- FIG. 10. Micro-photograph of thin section of diabase between crossed nichols, showing ophitic structure. It contains plagioclase (Pl), augite (A), and magnetite (M).
- FIG. 11. Micro-photograph of thin section of Essexite from Gran, Norway, showing hypidiomorphic augite crystals (A), and opaque grains of magnetite (M) in a fine ground mass of plagioclase. It illustrates hypidiomorphic-porphyrific texture.
- FIG. 12. Porphyritic basalt (melaphyre) with phenocrysts of plagioclase (Pl) in a dense micro-crystalline ground mass consisting of augite, magnetite and a second generation of plagioclase crystals.

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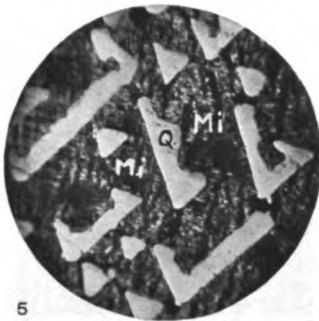
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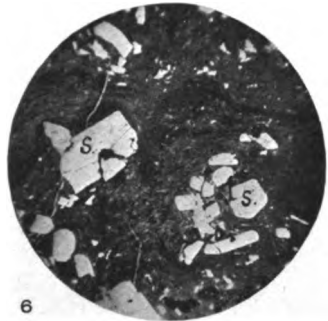
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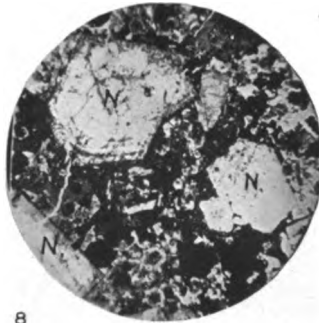
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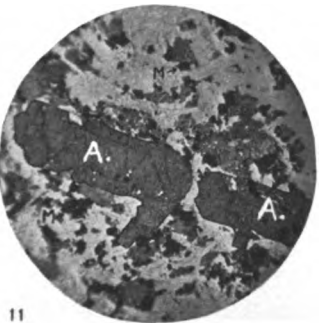
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phelite, having the composition $K_2Na_2Al_2Si_2O_{10}$. Chemically leucite resembles orthoclase feldspar. In addition to being chemically like orthoclase, leucite, like its counterpart, alters to kaolin. But more interesting still is the fact that on decomposition it has been known to furnish orthoclase or orthoclase and muscovite.

Nephelite, as its chemical composition indicates, is analogous to the plagioclase feldspars. It is hexagonal in character. The decomposition of nephelite, like that of the plagioclases, usually results in the formation of some one of the zeolites, or more rarely it forms kaolin.

GROUP IV.

Mica.—Two species here are of widespread occurrence; one is muscovite, the white, silvery, potash variety, having a chemical composition corresponding to $H_3KA_2(SiO_3)_2$. Chemically it is closely allied to orthoclase, and frequently results as an alteration product of that mineral. Optically it is distinctly biaxial. The second species, biotite, is dark-colored, owing to comparatively high percentages of iron. It also contains varying amounts of magnesia, and might thus be properly classed with the following group of minerals. It is very nearly uniaxial. It has the chemical composition $(HK)_2(MgFe)_2(AlFe)_2(SiO_3)_2$.

GROUP V.

The Ferromagnesian Minerals.—The minerals of this group take their name from the fact that they contain iron and magnesia as two of their prominent constituents. In addition they may contain lime and alumina in considerable amounts, also some alkali. The more important members of the group are included under the amphiboles and the pyroxenes, two species having numerous varieties, which pass into each other by isomorphous mixture. They form two parallel series which are both chemically and crystallographically analogous. Their relationship can best be shown by the following table:

Amphibole	
(a) Orthorhombic	
Anthophyllite	$MgSiO_3$
(b) Monoclinic	
Tremolite	$CaMg_2(SiO_3)_2$
Actinolite	$Ca(MgFe)_2(SiO_3)_2$
Hornblende	$\{ Ca(MgFe)_2(SiO_3)_2$
Glaucofanite	$\{ CaMg_2Al_2(SiO_3)_2$
(c) Triclinic	$NaAl(SiO_3)_2, MgSiO_3$
Ænigmatite	$Na_4Fe_2AlFe(Si,Ti)_{15}O_{38}$
Pyroxene	
(a) Orthorhombic	
Enstatite	$MgSiO_3$
Hypersthene	$(Mg,Fe)SiO_3$
(b) Monoclinic	
Diopside	$MgCa(SiO_3)_2$
Augite	$\{ CaMg(SiO_3)_2$
Acmite	$\{ MgAl_2SiO_6$
(c) Triclinic	$NaFe(SiO_3)_2$
Rhodonite	$MnSiO_3$

The really important rock-forming amphiboles and pyroxenes are to be found among the orthorhombic and monoclinic varieties. And it is necessary to distinguish here between those which are aluminous and those which are non-aluminous, for the special reason that the former on alteration produce chlorite, while the latter produce serpentine.

One other important rock-former must be mentioned as belonging to this group—olivine,

so called on account of its usual olive-green color. It has the chemical composition $(Mg,Fe)_2SiO_4$, is orthorhombic in crystallization, and readily decomposes to serpentine.

GROUP VI.

Ores.—Minerals of this group have iron as their principal constituent, and frequently constitute ores of that substance. Included here are:

Magnetite	$FeFe_2O_4$
Pyrite	FeS_2
Hematite	Fe_2O_3
Ilmenite	$FeTiO_3$
Chromite	$FeCrO_4$

Thus far the mineral species enumerated are mostly found as the essential constituents of that class of rocks hereafter to be described as igneous.

GROUP VII.

Accessory Minerals.—Those minerals which are usually of subordinate importance, and which are therefore more in the nature of accessory than notable rock-constituents, are included here:

Cassiterite	SnO_2
Rutile	TiO_2
Titanite	$CaTiSiO_5$
Apatite	$Ca_4(CaF)(PO_4)_3$
Monazite	$(Ce,La,Di)PO_4$
Corundum	Al_2O_3
Spinel	$MgAl_2O_4$
Garnet { Almandite	$Fe_3Al_2(SiO_4)_3$
Grossular	$Ca_3Al_2(SiO_4)_3$
Staurolite	$Fe(AlO)_4(AlOH)(SiO_4)_2$
Chiastolite	$Al(AlO)_4SiO_4$
Kyanite	$(AlO)_2SiO_3$
Fibrolite	Al_2SiO_5
Cordierite	$(Mg,Fe)_2Al_4Si_2O_{15}$
Tourmaline	$(Na,Mg,Al)_3(AlFe)_3(BOH)_4Si_3O_{38}$
Topaz	$(AlF)_2SiO_4$
Fluorite	CaF_2
Zircon	$ZrSiO_4$
Allanite	$(CaFe)_2(AlCaFe)_2AlOH(SiO_4)_3$
Zoisite	$Ca_2Al_2(AlOH)(SiO_4)_3$

Some of the above minerals occasionally come to be of considerable importance, or may even constitute the bulk of the rock-mass. As a rule, however, they are of minor consideration and frequently even negligible.

GROUP VIII.

Secondary Minerals.—Minerals of this class have originated as the result of the decomposition or alteration of some previously existing primary or original mineral. The most noteworthy are:

Kaolin	$H_4Al_2Si_2O_9$
Serpentine	$H_4Mg_3Si_2O_9$
Talc	$H_2Mg_3(SiO_3)_4$
Chlorite	$H_2(Mg,Fe)_5Al_2Si_2O_{18}$
Epidote	$\{ Ca_2Al_2(AlOH)(SiO_4)_3$
	$\{ Ca_2Fe_2(FeOH)(SiO_4)_3$

Kaolin results from the decomposition of orthoclase and other feldspars by the loss of some of the silica and alkalis, and by the addition of water (hydration). Serpentine results from the alteration of olivine and the non-aluminous hornblendes and pyroxenes by the loss of some of the magnesia and by an addition of water. Talc is formed by the hydration and partial decomposition of several of the lime-magnesia or non-aluminous ferromagnesian minerals, namely, tremolite, pyroxene (chiefly enstatite), phlogopite mica. Chlorite results most

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frequently from the alteration of the aluminous hornblendes and pyroxenes. Epidote also results from the alteration of the aluminous varieties of hornblende and pyroxene, especially those having some lime in their composition.

GROUP IX.

Precipitations from Aqueous Solutions.—The following minerals occasionally form im-
potheses are at present recognized as possible
tion from solution in water:

Salt	NaCl
Gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
Aragonite or Calcite	CaCO_3
Hydrous Silica	$\text{SiO}_2 \cdot n\text{H}_2\text{O}$
(Geyserite or Silicious Sinter)	

Origin of Rocks.—Two alternative hypotheses are at present recognized as possible explanations of the origin of the earth: (1) the old so-called nebular hypothesis, propounded by Kant and Swedenborg and later elaborated by Laplace and others; (2) the newly proposed accretion theory or planetesimal hypothesis propounded by Professor Thomas C. Chamberlin of the University of Chicago. The first of these supposes that the earth was originally in a gaseous condition, from which, under its own gravity and by a radiation of its heat, it passed into a fluid state and thence to a solid form. The "original crust" of the earth (lithosphere) formed at the surface as the result of a cooling of the molten materials of the globe. Furthermore, the earth may have solidified from the centre outward as the result of pressure. Others suppose that the original crust was not only added to from below by the crystallization of molten material, but also increased in thickness from above by chemical precipitations from the intensely heated hydrosphere. The accretion theory, on the other hand, supposes that the earth as a whole never was in a gaseous or even fluid condition, but was built up by the infalling of cold, solid, discrete particles of matter called planetesimals; that the present internal heat is the result of pressure due to gravity. Adherents of both these hypotheses agree, however, that the oldest known rocks, the original or primitive rocks from which all others have been derived, are of igneous origin, that is, were once in a molten condition, from which they cooled to the solid state, and in so doing formed more or less thoroughly crystalline aggregates of different kinds of minerals.

In discussing the origin and descent of rocks we must therefore start with the more common igneous varieties, and show how they have furnished materials for the others.

Rock Disintegration.—Granite is one of the most abundant and widespread of igneous rocks, and is a most important species among the numerous other primitive rocks of the lithosphere. The changes which take place in it in the process of its decay can be taken as illustrative of those which take place in the disintegration of all other primitive rocks. Granite consists of quartz, orthoclase feldspar (with some soda-orthoclase microcline or plagioclase), and light or dark mica, or both, or perhaps hornblende in place of the micas.

On decomposition under the influence of atmospheric agencies, it falls to a more or less rusty, clayey mass of sandy or gravelly material,

the sandy or gravelly part consisting of angular fragments of the original quartz (which is practically unaffected by atmospheric agencies), and fragments of still undecomposed feldspar. The clayey portion of the alteration products results from the decomposition of the feldspar and consists largely of kaolin, which in a pure condition is a white powdery or plastic material, according to whether it is dry or wet. It is usually stained rusty brown by iron oxide, which results from the decomposition of any ferromagnesian constituent contained in the rock, or from small particles of some one of the ores which are quite certain to have been present in small amounts. Certain constituents of the original minerals are carried off in solution: the alkalis and a part of the silica of the feldspars; also a portion of the iron of the ferromagnesian minerals, together with some of the magnesia and much of the lime that may have been present as a minor constituent.

This mass of loose, more or less rusty, incoherent material remaining behind is termed residual granite. Rocks of whatever nature are in like manner subject to decomposition by atmospheric agencies, and their residual materials everywhere cover the greater portion of the surface of the underlying rocks, and constitute what is termed mantle-rock or detritus. A part of this mantle-rock consists not of residual material in the strict sense, but is made up of angular fragments of various sizes, which have been broken from the rock-masses by the action of frost. At the foot of nearly every steep cliff is to be found an accumulation of angular rock-fragments called talus, rock-slide, or breccia.

Removal of Rock-waste and Its Deposition in the Form of Sediments.—Most of the various materials of the mantle-rock, whether residual or fragmental, find their way sooner or later, chiefly by the action of rain or frost, to the neighboring streams, and are borne by them to the rivers, which in turn transport them, after numerous halting-periods, to the sea or to smaller bodies of salt or fresh water. In this process of transportation the angular rock-fragments are reduced by attrition to rounded pebbles. The angular grains of quartz also become rounded and water-worn, while much of the material becomes reduced to an impalpable mud. These more or less finely comminuted and abraded materials are distributed along the shores of lake or sea. Gradually the finer, more easily suspended and transportable materials are carried out into deep water, the finest and most impalpable muds being transported farthest from the shore; so that, broadly speaking, the washings from the land surface become distributed over sea and lake bottom in order of fineness, beginning with the coarsest gravelly materials at the shore-line, and growing successively finer toward the deep water, where finally only the impalpable silts and muds are deposited.

Stratification.—In addition to this more or less gradual horizontal change from coarse to fine materials brought about by the transporting power of water, there is always to be observed a much more sudden and abrupt change vertically, by which materials of various sorts and degrees of fineness are arranged by the sorting power of the same medium (water) into horizontal beds of varying thickness, which are separated from each other by sharply defined planes of demar-

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cation called sedimentation or bedding planes. Beds which consist of the same material mineralogically are called strata. But a stratum may be made up of thinner beds, owing to a difference in the fineness of the material which composes it. These subdivisions of a stratum are called layers, and layers in their turn may be composed of extremely thin beds, only the very small fraction of an inch in thickness, called laminae. Strata vary in thickness from a few inches to several feet. All materials deposited in water are called sediments; and all sediments were originally deposited in nearly horizontal position. These nearly horizontal strata slope or dip slightly toward deep water, and this slight inclination is known as initial dip. All materials deposited in water are stratified, and this is the chief characteristic of all rocks so formed. The converse statement of this is that all stratified rocks are of aqueous origin. Rocks of this character are called sedimentary.

Consolidation of Sediments into Coherent Rock-masses.—Sediments have accumulated to a very great thickness during geologic time. Those sediments which have been deeply buried and have been subjected to great pressure have been made to cohere either as a direct result of this pressure or by a cementing together of the particles by mineral substances in solution; namely, silica, carbonate of lime, carbonate of iron precipitated as the oxide.

The Metamorphism of Sediments.—Those most ancient of all sediments which were derived from the disintegration of the original or primal rocks of the lithosphere, and which were first deposited in the primordial seas, have been so deeply buried in the crust of the earth as to have been affected by the uprising heat of the earth's interior. This heat, united with the tremendous pressure exerted by the superincumbent mass of sediments and the dissolving effect of the intensely (super-) heated moisture present, reduced the sediments to a partly fused, partly dissolved, more or less pasty condition (aqueo-igneous fusion), from which they subsequently cooled, thereby changing into thoroughly crystalline masses, consisting of distinct mineral aggregates more or less resembling the crystalline rocks of the igneous type, but different from the latter chiefly in this, that the original stratification (bedding) planes are still visible. Such rocks are utterly changed in everything except their chemical composition from their original condition and appearance, and are said to be metamorphosed. As a class they compose the metamorphic rocks. It is not alone these ancient sediments which have suffered transformation. Sediments of every geologic age have been found in some quarter of the globe in the metamorphosed condition.

General Classification of Rocks.—All rocks can be classified according to their origin as follows: (1) igneous; (2) aqueous; (3) æolian; (4) glacial; and (5) metamorphic.

Igneous Rocks.—(Definitions depending upon external form and mode of occurrence.) Igneous rocks comprise all those portions of the lithosphere which are or were in an intensely heated and more or less fluid condition and which have subsequently solidified by cooling into massive, more or less crystalline bodies of varying sizes and shapes. They occur as in-

trusions into or replacements of some previously existing rocks of the lithosphere, either sedimentary, metamorphic, or igneous. Where a huge mass of molten material slowly melts its way from some deep-seated portion of the earth up into the overlying rocks by dissolving them and incorporating them in its own mass, and subsequently cools there, slowly, without ever reaching the surface, forming a great irregular body of coarsely crystalline matter frequently scores of miles in extent, we have what is termed a batholith. In its molten condition it would be termed a magma and the reservoir in which it was contained would be called a magma basin. The period of its existence as a fluid mass is termed the intratelluric (within-the-earth) period. It might have extending from it (usually upward) irregular, more or less elongated, arm-like processes called apophyses. Should cracks or fissures form, they would be instantly filled by the inrush of fluid substance, which would solidify with comparative rapidity to form dikes. In stratified rocks dikes usually cut at some angle across the strata. Where the molten material intrudes itself between the strata parallel to the bedding planes in broad sheets, it is called an intrusion-sheet or sill. Where the overlying strata become lifted and arched upward into a huge dome without breaking above and letting the fluid rock escape, the solidified lenticular mass constitutes a laccolith or laccolite. Where the molten rock actually escapes to the surface by means of a fissure or other conduit, and flows out over it in a broad sheet, it is termed a flow, lava-flow, or intrusion-sheet. The interval of time elapsing between the outbreak of the magma from its reservoir and its subsequent cooling to the solid state is termed the effusive period. If the conduit is rudely cylindrical the lava accumulates about the vent, forming a lava or volcanic cone. Subsequent erosion may entirely remove the cone and expose the cold lava in the conduit, to which the term volcanic neck is applied. In fact it is only through the exposure of these deep-seated masses of cooled igneous material by erosion that we are enabled to study them. Over the more ancient land areas many miles of rock, vertically measured, have been removed, laying bare the underlying rocks to a corresponding depth.

The Modern Conception of Rock Magmas.—The popularly accepted idea of lava is that it is rock which has been fused by great heat. In fact the older conception of scientific men was that magmas consisted of fused rock-masses. Recent opinion, however, based on the revelations of the microscope and experiments in the synthesis of minerals and rocks, tends to regard them as solutions of one mineral substance in another or of several mineral substances mutually in each other. One of the chief reasons for thinking them such can be stated as follows: If magmas are fusions then the individual mineral constituents potentially present in them should crystallize out according to their fusibilities, beginning with the least fusible, but they do not. On the other hand, as the magma slowly cools, the first individual mineral species makes its appearance when the point of saturation for that particular species is reached, and the others follow in the order of their solubilities. For example, in granite (which consists

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of quartz, feldspar, and mica or hornblende, with some accessory constituent, such as apatite, or zircon, and, it may be, also a small amount of one or more of the ores), the order of crystallization is: (1) the ores with apatite and zircon; (2) mica or hornblende; (3) feldspar; (4) quartz. Quartz is the least fusible, and should appear first under the fusion theory. As a matter of fact it appears last. In short, all of the materials appear in the reverse order of what we would expect if they are true fusions. But they do appear in the order of their solubilities. Pressure, however, exerts an important influence upon the solvency of a substance, and as this is variable the order of appearance is not absolutely fixed. Moreover, heat, the most important factor involved, is very variable, and still farther modifies the problem.

The Splitting or Cleavage of Magmas (Spaltung).—When a magma cools, the first minerals to appear are the ores (with apatite, titanite, zircon, etc.); following these, the basic ferromagnesian constituents; then the more basic plagioclase feldspars, followed or overlapped by the orthoclase varieties; and last of all, quartz, if more than enough exists for the formation of the silicates. Obeying the principle of diffusion, the first minerals to form—the more basic ones—tend to accumulate on the cooling walls, that is, at the periphery of the magma-basin; and the other minerals arrange themselves rudely in concentric zones, each zone toward centre being successively more acid, until at the centre the magma becomes comparatively acid and may, after solidification, consist largely of such minerals as orthoclase and quartz. This arrangement of the minerals by diffusion before crystallization results in the rude separation of an originally uniform magma into several magmas of different chemical compositions, which, on cooling, furnish rocks of different mineralogical compositions. This process is termed the cleavage of magmas.

Definitions depending upon internal characteristics will next be considered.

Texture.—The fluid magmas of igneous rocks may be compared to molten glass. If the cooling period be long the individual minerals form comparatively large crystals. If it be short the crystals are correspondingly small. If it chills so suddenly that the molecules of the different mineral compounds do not have time to unite to form crystals, but are caught just as they existed originally in the fluid magma, the result is a volcanic glass. Rocks in which the crystals are 5 millimetres or more in diameter may be called coarse-grained; rocks in which the crystals range in size from 1 to 5 millimetres, medium-grained; and those in which they are 1 millimetre or less in diameter, fine-grained. Rocks in which all of the original magma has individualized or crystallized, to form minerals of some sort, and in which there is no undifferentiated material remaining behind in the form of glass, are called holocrystalline. All rocks in which the crystals are large enough to be seen with the unaided eye are termed phanocrystalline, or phaneric. Those rocks in which the crystals are too small to be distinguished megascopically are called aphanitic. Many aphanitic rocks, however, under the microscope are seen to be holocrystalline and to consist of small crystals of minerals which can be specifi-

cally identified with the aid of that instrument. For these rocks the term microcrystalline has been proposed. But the crystals, though recognizable, may be too small to be specifically identified even with the microscope. Such rocks are called microcryptocrystalline. Volcanic glasses show only embryonic crystals (microlites, trichites, crystallites) imbedded in textureless glass. Such rocks are said to be vitreous or glassy.

If during the entire period of solidification the conditions of cooling remained the same and the entire process of cooling of a deep-seated magma was slowly and quietly accomplished in the magma-basin, unattended by any effusive period, the rock would be coarse (to fine), evenly-granular. In rocks cooling under these circumstances the growing crystals have usually interfered with each other in such a way as to mutually destroy their crystal boundaries, forming irregular interlocking grains, with no one diameter much greater than the others. In other words, the grains are irregularly rounded. A texture of this sort is characteristic of the granites, and is called the granitic or granitoid texture. The term allotrimorphic, referring to the fact that the crystals do not possess their own boundaries, is applied to the same texture, and a still newer term, xenomorphic, has recently been proposed. Where the majority of the crystals do retain their crystal boundaries, the resulting texture is called idiomorphic or automorphic. If the crystal boundaries are only faintly or imperfectly discernible, the structure is said to be hypidiomorphic.

The period of intratelluric solidification may be interrupted by an effusive period; in which case those crystals which had begun to form, and may have reached considerable size, during the intratelluric interval, are carried by the eruption into other surroundings, where the cooling process may be much accelerated. A second generation of smaller crystals would then form about the large well-formed ones, imbedding them in a fine-grained or possibly aphanitic ground-mass, producing what is termed porphyritic texture. Two or more generations of crystals may thus be recognized. The well-defined crystals of the first generation are usually pronouncedly idiomorphic, and are called phenocrysts. The term felsite is applied to the aphanitic ground-mass of the acid rocks.

The crystals of some one mineral species in a rock may have one diameter much larger than the others. The crystals then appear distinctly lath-shaped in thin section under the microscope. This form of crystallization is especially common with the plagioclase feldspars. These laths of plagioclase are enclosed by crystals of another species. This texture is common, and in the scheme of classification of igneous rocks at present accepted is called into rather prominent requisition. It is known as the ophitic texture.

Flow-structure is exhibited by the parallel arrangement or orientation of minerals in lines which indicate the direction in which the fluid rock had been moving before solidification took place, or while it was in a viscous state.

Classification of Igneous Rocks.—The classification of igneous rocks as at present widely accepted is based upon three things: (1) chemical composition; (2) mineralogical composition; (3) texture. (The proposed 'Quantitative

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Classification of Igneous Rocks, published jointly by Cross, Iddings, Pirsson, and Washington, University of Chicago Press, 1903, is the most logical and satisfactory attempt at a thoroughly scientific classification of the igneous rocks yet proposed, and bids fair to be epoch making.)

Chemical Composition.—The chemical composition of igneous rocks is primarily expressed in terms of silica percentage. Rocks which contain from 60 to 80 per cent of silica are called acid. Most of these rocks contain free quartz; those which range from 40 to 60 per cent in silica are called basic, and rarely possess free quartz in any considerable amount; while those which fall below 40 per cent are termed very basic. Generally speaking, as the silica percentage declines the percentage of the bases (lime, iron, magnesia) increases. This change in chemical composition from acid to very basic is indicated by change in color, the acid rocks being light ashy gray, while the very basic are dark.

Mineralogical Composition.—Quartz is more or less abundant in rocks of the acid division, but soon disappears in passing toward the basic end of the series. Orthoclase is the dominant feldspar among the acid rocks, but even here the plagioclases are more or less common. Among the basic rocks the plagioclases prevail, and in a general way change from the albite to the anorthite variety as the more basic rocks are approached, but fail entirely in most rocks of the very basic division.

The ferromagnesian minerals are subordinate, almost negligible, in the very acid rocks. They become dominant in the basic and constitute the bulk of the very basic rocks.

The ores, chiefly magnetite, chromite, and ilmenite, are found more or less sparsely disseminated through all three divisions, but they become notable constituents among the basic and very basic rocks, and may even segregate to form important bodies of ore.

Texture.—As already explained, magmas which solidify deep within the lithosphere usually form coarse (to fine) evenly-granular rock-masses, having the granitoid texture, although they may be more or less porphyritic or idiomorphic in character. These deep-seated rocks are called plutonic. Where eruption takes place those rocks which solidify somewhere between the magma-basin and the surface (as intrusion-sheets, dikes, laccolites, etc.) are called intrusive, while those which cool subaerially (or it may be beneath bodies of water) are called effusive or extrusive. While neither the plutonic, intrusive, nor extrusive members are limited to any one kind of texture, it is true that the plutonic rocks are more frequently granitoid, and the intrusive and extrusive members even-fine-grained, felsitic, aphanitic, or porphyritic in texture, while the textureless volcanic glasses are nearly always extrusive.

Rock-families: I. Acid Division; Granites.—The granites are plutonic rocks occurring frequently as huge irregular masses which have slowly melted their way up from some deep-seated region into the more ancient and then deeply-buried portions of the lithosphere; or they may occur as apophyses or dikes given off from some parent mass. Mineralogically they consist of quartz, dominant feldspar of the orthoclase variety (with subordinate amounts of

soda-orthoclase, microcline, or oligoclase), and muscovite or biotite mica, or both. Typical granite has muscovite. Where biotite alone is present it is called granitite. Where hornblende or tourmaline replaces the mica, the rock is called hornblende- or tourmaline-granite. Where mica fails and the rock consists of quartz and orthoclase, it is termed aplite. Where feldspar fails and only quartz and mica remain, the rock is called greisen. Aplite and greisen are the most acid forms of the granites. As accessory constituents might be mentioned, zircon, allanite, cassiterite, rutile, titanite, magnetite. By a gradual decrease of quartz the granites pass imperceptibly into the syenites (to be described later), and by similar changes into the diorites.

There is a form of granite called pegmatite, which is found in veins or dikes. It is very coarsely granular. The crystals of feldspar sometimes measure a foot or more in diameter, while the quartz and muscovite crystals correspond in size. Pegmatite is the source of nearly all of the white mica of commerce. It is also remarkable as being the home of a variety of extremely rare minerals—compounds of thorium, lanthanum, yttrium, etc.—among which may be mentioned uraninite or pitch-blende, the present source of radium. Pegmatite is characterized by the interesting parallel intergrowth of feldspar and quartz, already referred to, called graphic granite. Pegmatite is particularly noteworthy, however, as having been deposited from an intensely heated aqueous solution, perhaps from vapor of water (mingled with other gases, such as carbonic acid, hydrofluoric acid, boracic acid, etc.), which was under such great pressure that it bordered on the fluid condition. The minerals of pegmatite, more particularly the quartz crystals, are frequently filled with fluid inclusions of water or carbonic acid. A great variety of minerals and a few rocks are considered to have been formed in this manner, and are said to be of pneumatolytic origin (Greek, *πνευματωδ*, to turn into air), and such processes are termed pneumatolytic processes. Furthermore, since these processes usually succeed some great volcanic outbreak, they are termed post-volcanic processes.

The granites as a family have a range in silica which varies between 65 and 80 per cent.

Where a magma of the chemical composition of granite erupts, it may form dikes, sheets, or flows. The rocks may have a variety of colors, but they are prevailing light ashy gray. Where crystalline, they possess the same mineral constituents as granite, except that the feldspar is apt to be the glassy variety of orthoclase called sanidine. The porphyritic texture prevails among the intrusive and extrusive forms alike.

The geologically older intrusives of this family are called quartz or orthoclase porphyry according to whether the phenocrysts imbedded in the felsitic ground-mass are quartz or orthoclase. The strictly extrusive forms of granite are known as rhyolites (from the Greek word which means to flow), so called because of the flow-structure which is commonly developed in them. The rhyolites are rarely holocrystalline, containing nearly always more or less glass, and occasionally consisting wholly of it. These entirely glassy forms of rhyolite are called obsidian. Perlite and pitchstone are varieties of obsidian. Occasionally the rhyolites are frothy

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in character, due to the rapid escape of steam resulting from the relief from great pressure. This form is known as pumice. Rhyolite is also called liparite because extruded abundantly from the volcanoes of the Lipari Islands.

Syenite.—The hornblende granites, as already explained, are those in which the mica has been replaced by hornblende. An occurrence of such a rock at Syene (now Assuan) on the Nile, was called syenite from its locality. Of late the term has been restricted to quartz-less rocks consisting primarily of orthoclase and hornblende. Rocks of the syenite family usually carry varying amounts of plagioclase, and may contain subordinate quartz. Apatite, zircon, titanite, and magnetite are uniformly present as accessory constituents. In texture they are granitoid and, by an increase of quartz, grade over completely into the granites, or by an increase of the plagioclase pass over into the diorites (described below). Where augite replaces the hornblende the rock is called augite-syenite; where mica replaces it, minnette. Nepheline and orthoclase constitute nepheline-syenite.

The range in silica percentage for the typical syenites is between 55 and 65 per cent.

When a magma having the chemical composition of a typical syenite erupts it forms dikes, sheets, and flows, closely resembling the eruptive forms of granite, but without quartz. The loosely applied mining term porphyry is used indiscriminately for the eruptive members of both the granite and syenite families. True eruptive syenite, however, is called trachyte, from the Greek word which means rough. The most typical occurrences are light-colored, ashy-gray rocks, either aphanitic or porphyritic in texture, with usually some glass in the ground-mass. When porphyritic the phenocrysts are of the glassy variety of orthoclase called sanidine. In fact, the entire feldspathic constituent is chiefly of this variety.

The eruptive form of nepheline-syenite is called phonolite because of the ringing sound which thin plates make when struck with a hammer, and certain dike-rocks of the mineralogical composition of nepheline-syenite with pronounced porphyritic texture, are called tinguaites.

Rock-Families: II. Basic Division; Diorites.—These diorites are plutonic rocks having a silica percentage running from 50 to 65 per cent. They are of medium acidity, and the magmas from which they are formed may be considered as approaching closely the hypothetical parent magma from which, by the process of cleavage, the other rock-families, acid, basic, and very basic, may be thought of as having originated. Mineralogically they consist of hornblende and plagioclase feldspar. Those in which mica replaces a part of the hornblende are called mica-diorites, while the same constituents plus quartz go by the name of quartz-diorites, granite-diorites, or tonalites. These rocks mark the transition to the granites. Augite-diorites are rocks of the diorite type, in which hornblende is replaced in part by augite. They grade over into the gabbros.

Certain intrusive (dike) rocks of the mineralogical composition of the diorites are called camptonites, while other similar intrusives having both biotite and augite are called kersantite.

Extrusive rocks having the chemical and mineralogical composition of the diorites are called andesites. Typical andesites are aphanitic, felsitic, or porphyritic in texture, and closely resemble the trachytes, the main distinction being that they contain plagioclase (andesine or oligoclase) instead of orthoclase. The ferromagnesian constituent is hornblende, but may be either biotite or augite. The rocks are named because of their common occurrence in the Andes Mountains.

Acid andesites containing free quartz are known as dacites, a name derived from the old Roman province of Dacia, now a part of Hungary.

The Gabbros.—The gabbros are coarse to fine-granular, granitoid rocks of plutonic origin, having a silica percentage ranging from 45 to 55 per cent. As originally defined they consisted of plagioclase (labradorite) plus a pyroxene, of the variety known as diallage; but more recently the name has been applied to a great variety of rocks consisting of a plagioclase (at least as basic as labradorite) plus any kind of pyroxene, either monoclinic or orthorhombic. If olivine be present it is known as olivine gabbro.

The name norite is applied to that member of the gabbro family which consists of plagioclase and enstatite. If olivine be present it is called olivine-norite. The ferromagnesian constituent may fail and the rock thus consist of labradorite feldspar alone, in which case it is known as anorthosite (from the French word for triclinic feldspar).

The accessory mineral constituents are apatite, titanite, ilmenite, magnetite. The first and last mentioned are usually abundant, and the latter may segregate to form ore deposits.

Diabases.—These may properly be discussed in connection with the gabbros, for they have the same mineralogical composition, and while they may occur as true plutonic rocks they occur commonly in the form of dikes or sills, and may be considered as the intrusive form of the gabbros. Their chief distinguishing feature perhaps is their texture, which, under the microscope, if not in the hand-specimen, is seen to be ophitic. This, in short, is the essential distinction between the gabbros and the diabases as ordinarily considered. In granularity they range from coarse to aphanitic. They are sometimes strikingly porphyritic, with perfect automorphic phenocrysts of augite imbedded in an aphanitic, ground-mass of augite and plagioclase (labradorite or anorthite). Dolerite is a term used interchangeably with diabase, but refers more particularly to the porphyritic varieties. The basalts or traps are the dense black aphanitic extrusive forms of diabase or dolerite, but they grade over into the diabases by imperceptible stages. The basalts constitute great surface flows of unparalleled extent, covering thousands of square miles. On cooling they frequently break, by shrinking, into hexagonal prisms, which have their long diameters normal to the cooling surfaces. This is known as the columnar structure of basalt, so famously exhibited at the Giant's Causeway, on the northeast coast of Ireland.

Olivine is a more or less constant mineral in the basalts, which have been divided into the

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olivine-free and olivine-bearing varieties. More rarely they contain nepheline or leucite in considerable amounts, and are then called tephrites. If both olivine and leucite or nepheline are present they are termed basanites.

Very Basic Division: Peridotites, Pyroxenites, Hornblendites, and Dunites.—Rocks of this division, as already explained, include those from which not only free quartz has disappeared, but also the feldspars, at least as notable constituents. They consist essentially of a mixture of ferromagnesian constituents plus one or more of the ores. Olivine and pyroxene (usually augite) together constitute peridotite (from the French word for olivine). If hornblende be substituted for augite the rock is known as hornblende-peridotite. If the rock consists essentially of pyroxene it is called pyroxenite; or of hornblende alone, hornblendeite, or of olivine alone, dunite. They have as accessory constituents magnetite, chromite, ilmenite, and apatite. Chromite rarely occurs in such abundance in the peridotites as to be of economic value.

A certain rare basaltic rock of the mineralogical composition of peridotite, consisting of augite and olivine in a glassy ground-mass, occurs at Limburg in Kaisersstuhl, Baden. It is called limburgite. Dense porphyritic rocks consisting of augite and magnetite in a glassy ground-mass represent the effusive member of the pyroxenites, and are called augites.

Rocks of Aqueous Origin.—Rocks deposited in water are called sedimentary, and are always stratified. In this respect they are distinguished from typical igneous rocks, which are unstratified and massive. Sedimentary rocks can be classified as follows: (1) mechanical sediments of terrigenous origin; (2) mechanical sediments of organic origin; (3) chemical precipitates.

Mechanical Sediments of Terrigenous Origin.—Included here are all those substances which have been washed from land surfaces and deposited in the seas or other bodies of water, as above explained. The principal varieties are: (1) Conglomerates, otherwise known as pudding-stones. These are solidified gravels, in which coherence is due to some cementing principle (lime, iron, or silica) to pressure, or to both. Where the fragments of rock are angular, as though freshly broken, the rock is called breccia. Breccias are not all of water origin. They are occasionally terrestrial. In either case they have not been transported far from the parent ledge, as their sharp corners indicate. (2) Sandstones, consolidated sand-beds. Where the cement is calcareous they form calcareous sandstones. They are also called silicious or ferruginous, according to the character of the cement. Argillaceous sandstones contain an admixture of clay. Coarse sandstones containing grains of undecomposed feldspar are called arkose. (3) Shales, solidified clays or muds. They may contain some sand, and are then said to be arenaceous; or they may contain lime in the form of shell-fragments or impalpable limy material, and are then called marls. Marls are thus in part of organic origin.

Mechanical sediments of the character above described accumulate alike in seas and lakes. Those deposits made in the sea are called marine; those made in lakes, lacustrine.

Mechanical Sediments of Organic Origin.—These may be the result of the accumulation of

either animal or plant remains. The accumulation of hard parts of animals, such as the shells of mollusks and other mollusk-like forms, the framework of coral polyps and echinoderms, and the microscopic skeletons of some of the protozoans, form the bulk of limestone and other chemically similar deposits. Coquina, the Florida limestone, is composed of a mass of mollusk-shells; crinoidal limestones of the fragmentary skeletons of those marine forms so abundant during Palæozoic time. Coral limestones are formed by the building up of coral reefs and by the accumulation of fragmentary coral materials and finely divided coral muds, which may be distributed widely over the floor of the ocean by currents, forming compact calcareous rocks. Calcareous accumulations of this particular sort are considered to have been changed to dolomites by the action of the salts of magnesium in the sea-water, on carbonate of lime, replacing part of the calcium by magnesium and forming $(Ca,Mg)CO_3$ out of $CaCO_3$. This imperfectly understood process, by which limestones are changed to dolomites, is called dolomitization. Dolomites and limestones grade into each other and together are among the most common and important rocks of the lithosphere.

Chalk is an accumulation of minute calcareous shells secreted by the lowest forms of animal life, the protozoans, certain forms of which abound in the surface waters of the oceans. When they die their shells rain down through the water and accumulate on the floor of the high seas, forming oozes. The chalks are considered to have originated in a similar manner during past geologic time.

Chief among the accumulations of plant remains is peat, an accumulation of vegetable materials in swamps or moist places. It is a dark brown or blackish residuum left by the partial decomposition of mosses and other vegetable accumulations, not always made strictly in the water, but always in moist places, and usually in the waters of swamps. Similar vegetable accumulations on a most extensive scale have been formed during past geologic time, and now constitute beds of lignite and bituminous and anthracite coal. Diatomaceous or infusorial earth is a silt-like deposit consisting mostly of the microscopic silicious shells of that low order of plants called the *Diatomacea*.

Chemical Precipitates.—Briefly enumerated, these are salt and gypsum, found in alternating beds, and considered to have formed by the evaporation of salt lakes, or by the isolation and evaporation of bodies of sea-water. Calcareous sinter or tufa consists of carbonate of lime, which has been brought up in solution in the waters of hot springs and deposited as porous or cellular material about their vents. It is also deposited from solution in the waters of rivers and lakes, and occasionally forms deposits of considerable extent. Travertine is a more compact form of the same material, as is also Mexican onyx.

Eolian Rocks.—In regions unprotected by vegetation, as along sea-beaches, the shores of lakes, or in the region of deserts, the finer sands are picked up by winds and drifted like snow into oval or rounded hillocks called dunes. Often these drifting sands are a menace to agriculture, since they gradually encroach upon and bury under them, the arable land. Sands thus deposited by winds are only rudely stratified. In

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the same manner fine impalpable dust is transported long distances, and gradually accumulates to form loess. The loess deposits of China are locally over 1,000 feet thick. Similar accumulations occur in the United States, Europe, and in Argentina. The Mississippi Valley loesses are believed to have been laid down in water under unusual conditions. True loesses are unstratified, and have a characteristic vertical cleavage.

Glacial Deposits.—The great continental glaciers that, geologically speaking, existed only yesterday over a large portion of the continents of the northern hemisphere, left behind them vast amounts of characteristic material, which was in part deposited by the glaciers directly and in part by the waters resulting from the melting of the ice. These latter deposits are therefore partly of aqueous origin, and are called fluvio-glacial. Glacial drift is the general term applied to all the materials resulting from glacial action direct or indirect. Glacial till is the dense bluish clay, with numerous imbedded boulders, characteristically striated, formed underneath the glaciers (sub-glacial material). This till-sheet (or ground-moraine) is found over a large portion of the area covered originally by the glaciers, and varies in thickness from zero to hundreds of feet. Other sub-glacial accumulations are called drumlins, till-billows, till-tumuli, crag-and-tail, etc. Materials dumped down at the margins of the glaciers in confused heaps are termed moraines (terminal, lateral, or medial). Streams flowing within or underneath the glaciers deposited along their courses material (sand, gravel, clay), which remained behind after the melting of the glaciers in elongated ridges called eskers or osars. Where these streams issued at the margin of the ice-sheets they left irregular mounds called kames. Streams flowing on the surface of the ice would likewise accumulate materials of the same sort, which would remain after the melting of the ice as long serpentine ridges known as super-glacial kames or eskers. These floods of water escaping from the glaciers carried the gravels, sands, and silts far beyond the margins of the glaciers, and deposited them as deltas, fans, overwash aprons, and valley trains.

Metamorphic Rocks.—The processes of metamorphism have already been described as the result of the action of heat, pressure, and moisture upon deeply buried sediments. There are two kinds of metamorphism: contact, and regional. Contact metamorphism is produced by the heat of intruded masses of igneous material upon the surrounding rocks. The contact zone or area about the intrusion affected by its heat is usually narrow, but it may extend for rods or even miles from the intruded mass. The changes resulting from contact metamorphism are not so important in the production of altered rock-masses as they are in the formation of new minerals, so that they are of more especial importance to the mineralogist.

Regional metamorphism, on the other hand, as the name implies, has been exerted over wide areas, and has produced the most profound and far-reaching effects. By it the rocks over many thousands of square miles have been completely altered from their original condition. Sediments consisting originally of loose materials

have been reduced to a fluid, semi-fluid, or pasty condition by the combined action of heat, which has penetrated into them from the interior of the earth, moisture, which everywhere saturates the lithosphere to great depths, and pressure, which at the depth of only a few thousand feet is well-nigh inconceivable. The fluidity of rocks thus produced is more or less akin to the fluidity of true igneous magmas, but with an essential difference. In the case of metamorphism the fluidity is due to solution of the mineral substances in water (superheated perhaps); while in the case of magmas it is due to the solution of one mineral substance in another, water being present as an accessory constituent. To this, heat and pressure must be added, also the pressure, with consequent heat, which comes from the lateral or tangential thrusting-in of the crust of the earth upon itself, due to the slow shrinking of the earth under gravity. As a result of this pressure the older deeper-seated rocks (as well as some of the more recent ones) have been intensely folded, plicated, and sheared, which folding and shearing alone would be sufficient to alter them completely. Metamorphic rocks have other structures developed in them, such as crushing; jointing (series of more or less parallel cracks intersecting each other at nearly right angles and breaking the rock-masses into blocks with rudely parallel sides); faults (produced by the slipping of the walls of rock on either side of a fissure over each other); slaty cleavage (produced by great pressure exerted at right angles to the cleavage surfaces); fissility (the visible separation of rocks into thin laminæ, also due to pressure, and attended by slight movement of the laminæ on each other); schistosity or foliation (the property of splitting into plates with rough undulating surfaces, due to the parallel orientation of the mineral crystals). This may be cleavage, fissility, or both.

These structures are not confined to the metamorphic rocks, but are common to the sedimentary and igneous. They are more frequent, however, in the older rocks. The same processes of metamorphism, so potent in the transformation of true sediments, are just as efficacious in producing changes in the igneous rocks themselves, by virtue of which processes the igneous rocks frequently become so profoundly altered as to be utterly unrecognizable.

The metamorphic rocks as a class are holocrystalline, and in this respect resemble the igneous rocks of plutonic origin. Their chief varieties will now be considered.

Gneisses.—Disintegrated or residual granite consists of disaggregated particles of quartz and more or less thoroughly kaolinized feldspar, with considerable true clayey residue resulting from the complete decomposition of some of the feldspar, all somewhat tinged by the oxide of iron. It is easy to see how a similar assemblage of materials could be brought together upon a sea-beach. By a subsidence of the area and a continued deposition of other sedimentary materials above them, that first assemblage of sand and clay might become so deeply buried as to come within the sphere of metamorphic action. If reduced to a more or less fluid condition by heat, pressure, and moisture, and subsequently allowed again to solidify, it would crystallize out

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as quartz, feldspar, and mica. In being so altered it would not necessarily have its original bedding-planes obliterated, and the rock would have the mineralogical composition of granite, but obviously would be of sedimentary origin. A metamorphic rock of such a character would be called gneiss. In the same manner a variety of mixtures might be altered with the same result. Conglomerates are known thus to pass by imperceptible gradations over into gneisses. An arkose might alter to gneiss. If the material originally contained much iron, then hornblende, or some other ferromagnesian mineral, such as biotite or augite, would result, and the rock would accordingly be called hornblende-, biotite- or augite-gneiss. Garnets might result from the metamorphism, and the gneiss would then be called garnetiferous. Fibrolite or cordierite might form, and the rock would be named accordingly.

Igneous rocks such as granites, syenites, or gabbros, by processes of metamorphism, may be altered into gneissic rocks. The chief metamorphic factor in the changing of igneous rocks to gneisses is, however, intense pressure, as a result of which even these most resistant of all rock-masses are made to flow like some viscous substance. This flowing, which is accompanied by more or less shearing, results in producing schistosity or foliation, which is accompanied by a distinct banding exactly simulating original bedding, so that the rocks lose their original massive form and come to resemble altered sediments. A granite in which this secondary banding or foliation had been produced would be called a granite-gneiss; a gabbro similarly altered would be termed a gabbro-gneiss, etc. In general we can say that a gneiss is any holocrystalline, foliated, metamorphic rock, of either sedimentary or igneous origin, which has the mineralogical composition of some one of the plutonic igneous rocks. It is frequently impossible to determine whether certain rocks are true sediments or altered igneous rocks.

Schists.—The term schist is applied to any holocrystalline metamorphic rock which, on account of the parallel arrangement of its crystal particles, tends to split more or less perfectly in parallel planes (schistosity or foliation). Clay upon metamorphosis yields mica. If little iron be present it furnishes muscovite (or sericite, its hydrated form), but if much iron be present it produces biotite. From this it follows that clay-beds on metamorphosis furnish mica of some sort or other, and as the rocks are always distinctly foliated, owing to the invariable parallel orientation of the mica-scales, they are called muscovite (or sericite) or biotite schists. Some quartz and feldspar may be present, but if subordinate they are still reckoned among the schists. Rocks of this character mark the transition of the schists into the gneisses. Staurolite, chistolite, kyanite, stilimanite, albite, and garnet are of frequent occurrence among the mica-schists particularly, and in such cases the schists are designated staurolite or albite mica-schist, etc. Mica-schists range in granularity from coarse- to micro-crystalline, the micro-crystalline varieties being called slates; the finely crystalline intermediate forms, phyllites.

Quartz-schists are essentially quartz-rocks, which contained originally some disseminated

clay that altered to mica, as a result of the presence of which the rock has a schistosity. Many basic igneous rocks of the diabase order on metamorphosis change to hornblende-rocks. Where they are foliated they are called hornblende-schists. If more or less massive they are termed amphibolites. The diabases are very apt, however, to alter to chlorite schists, especially if the original augite was of the aluminous variety, and they may alter to biotite schists.

Other Metamorphic Varieties.—Pure quartz-sand metamorphoses to a holocrystalline rock called quartzite. Limestone metamorphoses to a more or less coarsely crystalline rock consisting of grains of calcite. If fine, even-granular, it is known as marble. If coarse-granular, it is called crystalline limestone or simply limestone. But the term marble is used to embrace all crystalline calcite rocks that are susceptible of a polish. Serpentine results from the metamorphosis of basic igneous rocks consisting largely of the non-aluminous varieties of hornblende or pyroxene and olivine. The peridotites are especially susceptible to this change. Anthracite coal results from the metamorphosis of bituminous coal, which in turn is derived from peat or lignite. In certain extreme cases of metamorphism anthracite becomes altered to a graphitic material.

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Rockstro, William Smith, English musical composer: b. North Cheam, Surrey, 5 Jan. 1823; d. London 2 July 1895. His first composition was a song 'Soon shall chilling fear assail thee.' In 1844 he studied under Sterndale Bennett and by his advice spent a year at the Leipsic Conservatorium. He was also one of seven specially selected pupils of Mendelssohn, and laid the foundation of his great theoretical knowledge under Hauptman. He edited a series of operas in vocal score, as 'The Standard Lyric Drama.' Rockstro ultimately concentrated his attention on musical archæology, and his deep and practical knowledge of the ancient methods was fully shown in the 'Dictionary of Music and Musicians,' to which he contributed many articles. He also published a valuable 'General History of Music.'

Rockville, rök'vīl, Conn., city in Tolland County; on the Hockanum River, and on the New York, N. H. & H. railroad; about 16 miles east-northeast of Hartford. Electric lines extend to Hartford, Ellington, and other nearby places. Nearby is Shenipsit Lake, of which Hockanum River is the outlet. The river has here a series of falls, making in all a descent of 280 feet, and furnishing Rockville with extensive water-power. The city was settled in 1716 by a colony from East Windsor, and was a part of the town of Vernon until 1889 when it was chartered as a city. There are about 20 manufacturing establishments of importance, chief of which are envelope factories, silk and woolen mills, gingham and satinet factories. The principal public buildings are the schools, churches, and the library. The latter cost over \$100,000. There are eight churches, a high school, public and parish schools, two private schools, and a public library. The government is administered by a board of alder-

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men, four members, and a council of eight members. Pop. (1910) 7,977.

Rockwell, Alphonso David, American physician: b. New Canaan, Conn., 18 May 1840. He was graduated at Kenyon College, and the College of Physicians and Surgeons in New York. He is a specialist in electro-therapeutics and neurology, having held a professorship in the former subject in the Post-Graduate School of Medicine and also in the New York State Women's Hospital. He was one of the three commissioners appointed to give advice on the establishment of the new method of execution by electricity adopted by the State of New York. He is the author of 'Relation of Electricity to Medicine and Surgery'; 'Nervous Exhaustion' (1901); and, with G. M. Beard, 'Treatise on the Medical and Surgical Uses of Electricity.'

Rockwood, Tenn., town in Roane County; on the Cincinnati, N. O. & T., the Rockwood & T. R., and the Tennessee Central R.R.'s; about 40 miles west-southwest of Knoxville, and 88 miles north by east of Chattanooga. It is in a coal region in which there are extensive deposits of iron ore. The chief industrial establishments are blast furnaces, foundries, machine shops, and coal yards. The trade is chiefly in coal and in iron products. Pop. (1890) 2,305; (1900) 2,899; (1910) 3,000.

Rocky Gap, Engagement at. On 5 Aug. 1863 Gen. W. W. Averell, with a brigade of cavalry and mounted infantry and a 6-gun battery, left Winchester, Va., for a raid into West Virginia, which was to be continued to Lewisburg and the Virginia & Tennessee railroad. He moved by way of Wardensville to Moorefield, and to the upper valley of the south branch of the Potomac, and then to Huntersville, driving back Col. W. L. Jackson's cavalry. As he approached White Sulphur Springs, on the morning of the 26th, he encountered Col. Geo. S. Patton, who, with four small organizations of infantry, two battalions of cavalry, and a battery, in all about 1,900 men and four guns, had been ordered to intercept him, and had taken position at Rocky Gap, the junction of the Huntersville road with the Lewisburg and Kanawha turnpike. Patton was strongly posted, and Averell opened upon him with artillery and disabled two of his guns; but successive charges by Averell's dismounted force, with efforts to flank him, continued during the entire day, failed to dislodge him, and at night, after nine hours' fighting, the contending forces occupied the same positions as in the morning. Averell intended to renew the fight next morning, but, learning that Patton had received reinforcements from Lewisburg, made arrangements to withdraw. At 10 A.M. Patton attacked his left and half an hour later Averell ordered a retreat, which was conducted in good order on the road to Warm Springs, and thence by way of Huntersville to Beverly, which was reached on 31 August. The Union loss was 25 killed, 125 wounded, and 67 missing, a total of 217; the Confederate loss was 20 killed, 129 wounded, and 13 missing, a total of 162.

E. A. CARMAN.

Rocky Mountain Goat, a goat-antelope (*Oreamnos montanus*), related to the chamois and serow, which inhabit the heights of the Rocky Mountains and Cascade Ranges between

the forests and the snow line, from the 44th to the 65th degree of latitude. It is about the size of a goat, but is stouter, handsomer and has stronger legs. It is completely covered with long, thick, white hair, which forms an erect mane along the middle of the back from between the horns to the root of the tail; the shoulders are rather humped, and the head is habitually carried low. Both sexes have slender, smooth, black horns, curving backward, about eight inches long and sharp-pointed. Its pure white coat is a capital protection against observation in the midst of the alpine snow, and is unique, as no other white ruminant is known. Dwelling in such solitudes they have little to fear from natural enemies, and fall an easy prey to the human hunter who has the hardihood to pursue them upon the rough mountain peaks, and skill enough to get near to them unobserved. "Their food," says Wister, "seems to be chiefly the short almost lichen-like moss that grows on the faces and at the base of the rocks, and between them in the crevices. . . . I am inclined to believe that the goat keeps consistently to the hills, whatever the season may be, and in this differs from the mountain sheep, as he differs in appearance, temperament and in all characteristics, except the predilection for the inclined plane; and in this habit he is more vertical than the sheep." A variety from the Copper River region, in Alaska, is marked by greater divergence of horns and some other structural characteristics, and has been called *O. kennedyi*. The flesh of the mountain goat is not very good, but its hair was utilized in weaving by the Indians of British Columbia and the coast northward; and its tanned hide has a value in market as a rug. Consult Stone and Crane, 'American Animals' (1902), and authorities on travel and sport in the Northwest.

Rocky Mountain Sheep. See BIGHORN; SHEEP, MOUNTAIN.

Rocky Mountain Subregion, a rather indefinite zoogeographical region embracing the elevated area occupied by the Rocky Mountains, which zoologically presents certain peculiarities very noticeable to a traveler from either the eastern lowlands or the Pacific coast. The resemblance in the fauna is, indeed, rather to the East than to the West, as the Rockies do not form a zoological "divide" to anything like the extent which the Sierra Nevada does, nor even as completely as does the line of deserts which occupy the great depression of Nevada and Idaho between the Wahsatch range and the Sierra Nevada.

A large number of species of animals and plants extend from the Mississippi Valley to and throughout the Rocky Mountains, in forms which are identical from one side of their wide range to the other, or which shade indistinguishably from one varietal extreme in the East to another in the West. On the other hand the plants and animals common to both California and Colorado are comparatively few. The dry and foodless deserts of the Utah basin form a more potent barrier than the snows and altitude of either Sierras or Rockies. Thus the buffalo formerly wandered throughout the whole network of interior valleys, and there is a special variety which seem never to have left the park-

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pastures and scantily timbered defiles; yet Bear River, Utah, on the border of the alkali basin, is the farthest west they ever got south of northern Idaho. The elk, grizzly and bighorn, the mountain goat, white ptarmigan and certain other examples of animals, are common to both the Sierra Nevada and the Rocky Mountain systems; but in all these cases they are species whose range extends far north where both lines of elevation converge in British Columbia. Yet the true "blacktail," or Columbian deer, is never shot east of the Cascades, nor does the Virginian, or willow deer, common enough in the Rockies, wander over to the Cascades or Sierras of Oregon and California.

To a more limited extent the Great Plains on the east serve as a barrier between the commingling of plants and animals indigenous to the mountains on the one hand and the Mississippi Valley on the other. And that this, as far as it goes, is a real barrier, is shown by the fact that many common weeds and trees, which flourish well in Colorado now, had never reached there until carried, either intentionally or accidentally by man; that is, the place was suitable enough to them, but they had never been able to reach it.

The Rockies, then, form a zoogeographical district, which embraces practically the whole system of complicated chains from New Mexico to the borders of Alaska, and there is a curious homogeneity throughout, a long list of insects, mollusks and animals of the lower classes, as well as of trees and herbs, occurring from the Rio Grande to the headwaters of the Saskatchewan, disregarding the difference in latitude, which in flat regions is the most powerful factor governing the distribution of animal and plant life.

This is not exceptionally the case in the Rocky Mountains alone, though here it is conspicuous and well-marked. It is true of the Ural-Carpathian system, of the Scandinavian ranges, of the Andes, of the great East-African system, of which Mounts Kilimanjaro, Kenia, and Gordon-Bennett are peaks; nor is it difficult of explanation. A great mountain-province is really a series of sub-provinces concentrically arranged, or, to put it in another way, heaped on top of one another, for the largest bound, embracing the whole extent of the mountains and their foothills, contains several more or less restricted areas, determined by altitude, just as a vast lowland province, such as the whole eastern half of the continent, contains several well-defined subdivisions according to zones of climate, succeeding one another from north to south. The cause of the natural division of these sub-provinces is precisely the same in both cases, for, whereas in the Mississippi Valley the cooler or warmer average temperature required by each animal or plant for its best development is obtained by moving to the north or to the south, so in a mountainous region too much cold or too much heat can be avoided by moving upward or downward, and climate varies with altitude instead of latitude.

Hence, naturalists who have studied the mountains are able to mark out successive sub-provinces, according to altitude, within the upper and lower borders of which certain forms of life are restricted, appearing neither below, or

above, a limited number of thousand feet, except as occasional wanderers. Botanists have long recognized this.

Of course the number of varieties steadily decreases as one ascends just as on approaching the poles, because the means of supporting life diminish in proportion as a moderate climate and abundant vegetation are left behind. The hardy grizzly can stray to the utmost heights, as he is fond of doing, for his strength, power of locomotion and fasting abilities make it possible; but even he cannot remain there long, since food is very scarce beyond the timber. The eagle and greater hawks may soar above the naked icy crest of the loftiest summits, or perch upon the pinnacles, but they seek their prey and build their nests for the most part at far lower levels. A few small birds, like certain semi-arctic warblers and sparrows (especially the gay *Leucosticte* finches) and one large one (the well-known ptarmigan), the little-chief hare or "cony," which stores in its rocky tunnels a winter larder of roots and stems gathered at the edge of the snow during the brief summer, and a small variety of beetles and other insects more or less subterranean in habits, alone brave the storms and famine involved in continuous residence upon the higher summits.

Next below lies the zone of hardy plants and of a longer list of animals, such as the Canada jay, dusky grouse, several hawks and owls, the kinglets, water-ouzel, snow-birds and *Zonotrichia* finches, the bighorn sheep, and a large variety of insects and snails. Below that, down among the pines and abundant shrubbery of the lower slopes and the foothills, one finds in summer the full measure of Rocky Mountain life.

An examination of these facts discloses that all the inhabitants of the lofty plateaus and the rocky peaks are arctic animals, and some of them, like the ptarmigan, turn white in winter in true arctic fashion. These creatures, finding the same conditions at those great heights to which they are accustomed at lower levels inside the polar circle, can live and flourish on an arctic island, as it were, in the midst of the temperate zone; the long narrow snow peaks of the great range forming a tongue of polar climate stretching half way to the equator. It has thus been possible for the beautiful white goat, whose proper home is in British Columbia, to stray south along the crest of the Sierra Nevada and Rockies as far as these high mountains run, but he must keep upon the very crest, whereas in Alaska he comes down to the shore. The insects and minute life of the peaks of Colorado belong to the same class with (are often identically the same species as) those collected by polar exploring expeditions. The same is true of plants. "Red snow" and arctic lichens may be gathered on Pike's Peak.

It is natural, then, that two different migratory movements should be observable in the Rocky Mountains; one the regular seasonal movement southward in the fall and back in the spring, affecting chiefly those birds that live at the base of the range, or near it; and another movement, which is regularly made by many animals, upward to the cooler and fresher pastures in the summer, and back to the less

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snowy and more sheltered dells near the base of the mountains as winter approaches. This vertical migration is very well understood in the case of the game, and the paths which the animals follow are often distinct.

The foregoing facts lead to an interesting generalization. While the southern peaks might be colonized by such stragglers from the north as the goat and the ptarmigan, whose legs or wings enable them to travel back and forth, there is a much longer list of small and practically stationary animals never found in the intervening valleys and totally unable to cross from one peak to another. Hence we must conclude that each lofty mountain top is a habitat by itself, entirely cut off from neighboring peaks where duplicates of its fauna and flora may be collected. On the tops of Mount Washington, in the White Mountains, and Mount Marcy, in the Adirondacks, are insects and cryptogamous plants which do not occur anywhere between these isolated fragments of polar climate and the arctic circle, where the same butterflies, spiders and lichens are widespread and indigenous.

How shall this isolation of strictly circumscribed faunas upon mountain peaks be explained? Clearly it dates back to a time when communication between them existed. The ice-cap which, during the last Glacial Epoch, gradually overspread a large part of the north temperate zone and in the Rocky Mountain region covered the whole extent of their highlands with a thick mantle of snow and filled every cañon with local glaciers, of course crowded southward all the surviving life which had been wont, during the warm Tertiary time, preceding this cold period, to dwell far toward the north.

But when the epoch was on the wane, and the ice-front began to retreat, the relieved earth was again clothed with vegetation and re-tenanted by cold-loving animal life, which advanced northward closely in the rear of the retreating glacier. At a greater distance followed the more delicate animals and plants, gradually spreading northward as the moderating climate permitted, until they had established themselves in isothermal zones as we now find them. But as a subsiding flood will leave, stranded upon the top of the first points to appear above the surface, the driftwood and wreck of the deluge, so, as the warmth of southerly regions at a low elevation has increased, certain colonies of the advance guard of the army of animals and plants have found themselves stranded upon frigid mountain tops — islands of arctic climate — isolated from their fellows by warm valleys and plains in which their kindred speedily disappeared, overcome in the battle for life by the greater increase of lowland species to whom the circumstances were more favorable; but here on the high cold peaks they have been able to keep a stronghold, each in its own in a limited area, though surrounded by utterly fatal conditions.

Consult authorities cited under ZOOGEOGRAPHY, especially the writings of C. Hart Merriam.

Rocky Mountain Trout. See DOLLY VARDEN TROUT.

Rocky Mountains, or Cordilleran System, the system of mountains which constitute the major axis of elevated lands of North America,

in the western part, extending from the Arctic Ocean on the north to South America on the south, and parallel with the Pacific coast. This great system of mountains is continued along the Pacific coast in South America under the name Andes Mountains (q.v.). Between the Rocky Mountains and the Andes is a pass in Panama not many feet above sea-level. The width of the system varies; the greatest breadth is in the United States, between lat. 38° and 42° N., where it is about 1,000 miles. The width diminishes north and south, increasing again in Mexico and diminishing only with the width of the continent. The highest point of the system is in Alaska, but the highest land mass is in the United States between 35° and 42° and on the eastern side of the system.

Ranges.—The ranges on the western boundary, and near the Pacific coast are the Cascade and Sierra Nevada in the United States, the Sierra Madre in Mexico and Central America. West of the Sierra Nevada, in California, is the Coast Range. The eastern chains in the United States, called the Rocky Mountain Range, extend north and northwest in the United States, approach nearer the Pacific in Canada, continuing into Alaska to the Arctic Ocean. On the east of the Rocky Mountain Range is the great central plain of the United States and Canada. Rising abruptly from this plain are many isolated cone-shaped peaks which gradually merge into ranges, forming an almost continuous eastern barrier, composed of short ranges, chief of which are Sangre de Cristo, Colorado or Front Range, Medicine Bow, Big Horn, and Laramie. Farther east, in South Dakota and Wyoming, are the Black Hills, a mountain mass detached from the main ranges. In Wyoming the ranges divide, some extending southeast, others southwest, and several short ranges having an almost east and west trend. Some of the well known interior ranges are Wahsatch, extending through Utah, and forming the eastern wall of the Great Basin, Wind River, Salmon River, San Miguel, and Beaver River. Bitter Root Mountains form the divide between the headwaters of the Colorado and the Missouri Rivers. In Nevada the short ranges are generally north and south, in the central and eastern part there are a large number of short, almost parallel chains. Other noted ranges are the Cœur d'Alene, the Lapwai, and the Blue. The ranges south of the divide in Wyoming have a greater altitude than those north; but some of the southern ranges after leaving Colorado on the south and east, end abruptly, and others slope gradually to the low desert plains. The greatest development is in Colorado.

Peaks.—In Colorado there are about forty peaks which are over 14,000 feet in height. Among them are Grays Peak, 14,341 feet in height; Longs Peak, 14,271 feet; Pikes Peak, 14,134 feet. In the Sawatch Range, in Colorado, are Mount Harvard, 14,375 feet, and Mount of the Holy Cross, 14,176 feet. In the mesa region in western Colorado is Uncompahgre Peak, 14,408 feet; and in Sangre de Cristo Range is Blanca Peak, 14,463 feet. Other famous peaks, outside of Colorado, are, in Wyoming, Fremont's Peak, 13,700 feet, in the Wind River Mountains; Mount Hayden, 13,691 feet, in the Sawatch Range. In the Colorado, or Front Range, there are four peaks over 14,000 feet;

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in Sawatch Range, 10 peaks; in the Sangre de Cristo, three; in the San Juan, four; in the Sierra Nevada, four. In Park Range (not group) and in the Pikes Peak Group, there is one in each. The highest peaks belong to the Cascade Range. Mount McKinley in Alaska, is over 20,000 feet above sea level; Mount Logan is 19,500 feet; Mount Saint Elias, 18,101; Mount Rainier, 14,444. Many of the peaks of this vast system, especially in the Cascade Range, are extinct volcanoes. In Mexico and Central America there are a number of active volcanoes. Orizaba, 18,300 feet in height; Popocatepetl, 17,887; and Ixtaccihuatl, 17,343, are among the highest active volcanoes.

Plateaus.—The great plateau region included in the Rocky Mountain system is in southern Wyoming, eastern Utah, eastern Arizona, western New Mexico, and western Colorado. The lands in Colorado and New Mexico east of the mountain ranges belong to the Great Plain. The Plateau region is bounded on the north by Sweetwater and Wind River Mountains. The general elevation of the whole plateau is about 7,000 feet above sea-level, but in Colorado it has an elevation of 10,000 feet. The Continental divide crosses this plateau; and within its limits are the waters of the three great river systems of the United States, the Mississippi, the Colorado, and the Columbia. The southern part of the plateau has in places an abrupt ending, a steep, almost perpendicular escarpment. The ranges crossing, divide the plateau region into sections to which have been given the names Kaibab, Kaiparowits, Aquarius, Colorado, Markagunt, Paunsagunt, Paria, Shiwits, Tavaputs, Uinkaret, and others not so well defined as those named. On these broad plateaus are groups of mountains, buttes, and isolated ranges and peaks. There are seven peaks over 13,000 feet above sea-level; five over 12,000 feet and less than 13,000 feet; and 20 over 10,000 feet and less than 12,000 feet.

Parks.—The Parks of Colorado are high mountain valleys, known as North, Middle, South, and San Luis, with an elevation of from 6,000 to 10,000 feet, surrounded by ranges of mountains from 3,000 to 4,000 feet higher. The west border of the San Luis Park is formed by San Juan Range, with its high peaks, more than 100 of them over 13,000 feet, bordering it like giant watch towers. The Uintah Range is west of North Park. The Parks, or enclosed mountain valleys in Idaho and Wyoming, are not so high as the Parks of Colorado. The most famous park in the whole Rocky Mountain System is Yellowstone Park (q.v.) in Wyoming, now a Government Reservation. The ranges on the boundaries of the Parks and rising from the Park Valleys, are grouped together as the Park Ranges or Park System. The mountains so designated are bounded on the north by the Laramie Plains, and on the east by the Great Plains. The southern and western boundaries are indefinite. Other noted parks are Monumental Park and the Garden of the Gods, near Colorado Springs. The 500 acres are covered with an extraordinary rock formation, like giant spires and pillars, and some like vast cathedrals. The Yosemite Valley (q.v.) is often classed with the Parks.

Desert Region.—Within the area called by this name are vast arid regions, bare bleak

mountains, and localities of almost barren lands, some of which might be made fertile by irrigation, and some fertile valleys. It includes the southern parts of Idaho and Oregon, the western parts of Utah and Nevada, the southeastern part of California, the southwestern part of New Mexico, the southern part of Arizona, and the north central part of Mexico. The Sierra Nevada and Cascade ranges are on the western boundary; and the plateau drained by the Colorado River is on the eastern boundary. The greater part of this region is known as the Great Basin (q.v.) which has no apparent outlets to the ocean. The ranges, as in Nevada, are simple and narrow and separated by broad, level desert valleys.

Passes.—Several depressions in the ranges are called Passes, and some have been used for routes for railroads. A famous pass is the Lewis and Clark's, in latitude 47°. Through this pass the Northern Pacific railroad has been built, and at Mullan's Pass it goes through a tunnel 3,850 feet long. The Truckee Pass, 6,000 feet above sea-level; the South Pass of the Wind River Range, Evan's Pass in the Front Range, which is crossed by the Union Pacific railroad, are all well known. In Canada the pass between Mount Hooker and Mount Brown, Athabasca Portage, is 7,300 feet above the sea. In the California mountains there are a number of passes. Where the rivers have cut their channels through the mountains, passes have been formed.

Lakes, Rivers, and Glaciers.—The greatest rainfall is on the western slope, where the moisture brought by the winds from the Pacific Ocean falls. In the valleys and on the plateaus, especially where the waters fall down the escarpments, the rivers run through deep cañons, the almost perpendicular sides of which are thousands of feet above the river beds. The rivers of the plateaus have their sources in the Park and Wind River Mountains, and in the Wahsatch Range. They have carved out deep gorges, which divide the region into a series of distinct plateaus. Some of the famous cañons of this region are the Grand of the Colorado, the Kanab, and the Marble. The principal rivers within this region are the Green, Colorado, Sevier, Paria, Uintah, and White. The rivers whose head-waters are in the Sierra Nevada Range, flow to the Pacific, except a few, which flow east and are lost in the sands. The Sacramento and the San Joaquin are in the valley between the Sierra Nevada and the Coast Range. The one river comes from the north, the other from the south, almost parallel with the ranges until they unite, when they burst through the mountains and discharge their united waters into the Pacific Ocean. The Columbia is one of the great rivers of this region. Rising on the east side of the Cascade Mountains it flows south for some distance until finally it plunges through the mountains in a series of magnificent cascades, whence the name of the range. The Front Range in northern Montana bears upon its crest for many miles the continental divide which separates the headwaters of the Missouri and the Columbia rivers. The Bitter Root Range separates the Missouri from the Salmon. The greatest water systems of North America have head-waters in the Rocky Mountains. The Colorado toward

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the south, the Yukon on the north, and the Columbia are the largest streams that flow toward the Pacific; the Mississippi, the Great Lakes and the Saint Lawrence, and the streams that flow into the Hudson Bay all reach the Atlantic Ocean; and the Mackenzie and its tributaries flow into the Arctic. The Rocky Mountains have many small lakes, formed by springs, and depressions which serve as basins. In the Great Basin are several bodies of salt water, the largest of which is Salt Lake (q.v.). The only crater lake in the United States is Crater Lake in the National Park. The glaciers of the Rocky Mountains are numerous. In Alaska are the largest and greatest numbers among which are Muir, and Malaspina. Mount Rainier (q.v.) has over 30 glaciers, extending over a space of 100 square miles, and some of the ice walls reach a depth of 1,000 feet. The Puyallup and Mowich rivers drain five of the largest glacier rivers of Mount Rainier. A notable feature of these rivers is what is known as glacial tides, which are quite marked in summer time. Between midday and a few hours before sunset, there is an increase in the flow of water at the head of each river; about two feet in the narrowest part of the rivers. The plan is already under way to construct a dam in Puyallup River at a point 1,900 feet above tide-water, and 35 miles from Tacoma, from which the water will be carried by a power canal to a point $10\frac{1}{2}$ miles below, to be precipitated into a large power house in the cañon. The power generated will be transmitted to Tacoma, Seattle, and other places. The vastness of Mount Rainier may be conceived when it is known that the surface, including the hill country at its base, has an area of 3,000 square miles, and scientists who have examined the mountain say it has the greatest ice covering of any elevation on the Western Hemisphere. In other parts of the Rocky Mountains are found vast glaciers, and many of the peaks are ever whitecapped with snow.

Geology.—The name "Rocky" Mountains is most appropriate to this vast elevation, for in the mountain range, on the plateaus and in the high valley are numberless naked rocks, such as are found nowhere else in America. The aridity of a large portion of the region prevents the growth of vegetation. Across the plateaus are long lines of cliffs, the sides seamed and carved, the debris accumulating at the base. The greater part of this region has been the scene of great volcanic action. The lava, ashes, and scoria are plainly visible. All the mountains of the Desert Ranges are somewhat similar,—a monoclinical ridge of displacement—a fault (q.v.) on one side and a flexure on the other. The strata, generally, dips one way, the escarped edges of the strata form the front or surface of the ridge. Secondary faults and flexures appear in many places. Granites, sandstones, limestones, and schists are found in many of the ranges of this region. The present arrangement of the mountains is not of ancient date, although this region, since Jurassic time, has been above the sea. The eastern ranges are composed of Mesozoic, Palæozoic, and Tertiary sediments, schists, and granites. The present formation is of the Tertiary period; but the irregularities and unconformities show that this section had alternate periods of sea sub-

mergence and of dry lands. The plateaus are separated, by faults and flexures, into blocks. The buttes have horizontal strata and escarped sides. Some of the plateau mountains had their origin in upheaval, and others are of simple anticlinal structure. The Uintah Range, on the north, has an east and west axis, and is the result of upheaval. The Zuni Range, on the south, is of the same type. Like other adjacent regions this shows alternating sea submergence and dry periods, but the plateaus, since the Cretaceous period, have been above water. During the early Tertiary and the late Mesozoic time the basin region was dry, but the plateaus had large lakes and seas. The present "block arrangement" of the plateaus began in the early Tertiary period. The plateaus are composed of the Mesozoic, Palæozoic, and Tertiary sediments. In some of the deep cañons are found granites and crystalline schists. The Sierra Nevada Range bears the marks of recent volcanic action. In the vicinity of Mount Shasta and Lassen Peak are volcanic masses, and on the west slope are vast sheets of lava. The Coast Range has the Appalachian type. The upheaval of this region began in the later Tertiary period; the ranges are made up of oppressed folds of strata, worn down by rains and rivers; the summits are tipped westward. The Cascade Range contains a number of extinct volcanoes. In Canada there are in the region of this range a number of volcanic plateaus. The whole Rocky Mountain area bears the marks of volcanic action. Much is known of the gigantic formations in this region, and the general geological features; but the scientific study of this vast section is in its infancy.

Minerals and Mining.—The Rocky Mountain section is the great treasure region of North America. Almost all the precious and useful minerals are found here in abundance. Gold had been discovered and used by the aborigines, and deserted mines have been found where mining had been carried on in a crude way as early as 1680. Gold exists in nearly all the ranges of the system. Gravel containing coarse gold is found from 20 to 60 and even 100 feet below the surface. Abandoned gold fields were worked over with great profit during the last decade of the 19th century, by using improved methods. There are rich deposits of silver, copper, iron, salt, coal, lead, and in the southwestern part of the United States, petroleum and gas. The placer gold regions in Alaska, and the gold fields of the same territory, have been found thus far (1904) of great extent and value. The value of the fine building stone, the fire-clay, gypsum, all kinds of cement material, are rarely taken into consideration because overshadowed by the value of the gold, silver and copper. The gypsum beds in the northwestern part of Texas and along the foot-hills of the ranges in southern Colorado are of great extent and value. (See separate States and Territories of the United States in the Rocky Mountain region, Canada, and Mexico for more details on MINING and MINERALS.)

Climate.—The west slope of the Rocky Mountains, or all that portion which faces the Pacific Ocean, has a milder climate than the central or eastern part of North America in the same latitude. The warm winds from the Pacific Ocean bring heat and moisture. The

rainfall is copious on the western side of the mountains. Like the mountain regions on all parts of the globe, the temperature lowers with increase of altitude, and the winds which here blow over the cold mountain tops and across the plateau region to the eastern slope carry with them neither heat nor moisture. In the southeastern part of this vast region where the mountains become low ranges or foot-hills, in the United States, west of the ranges that parallel the coast, the climate is hot in summer and mild in winter; in the Great Basin region and on the eastern slope of the mountains, extending out on the Great Plains, the climate is marked by aridity. (See UNITED STATES.)

Flora.—The great aridity of the region east of the western or coast barrier prevents the growth of vegetation. The surface is exposed to erosive action which is specially rapid at such great elevations, and the denudation becomes more complete as the sand and small disintegrated fragments are swept away by the winds, thus giving no opportunity for the accumulation of soil. A large portion of the central and eastern mountain region, and the western part of the Great Plains require irrigation in order to have vegetation; this is so even in the parts where there is abundant fertile soil. The arid portion of the United States, exclusive of Alaska, is about two fifths of the whole area. The redemption of the arid lands is one of the Nation's problems. Less than 10 per cent of the mountain region is forest-clad; but a larger proportion is covered with verdure, including the portions covered with dwarfed herbage, sage brush, and stunted cedars and pines, most of which is useful for fuel but not for building purposes. Crops that mature in a short season and pasturage grasses are found on the foot-hills and valleys, especially along the streams. In some places where a little moisture is carried over the passes, below the snow line, the mountains are covered with the dark evergreen growth of hemlock, spruce, balsam fir, and tall pines; and still further down are interspersed among them the birch, beech, cherry, and various other trees, while along the streams are found groves of cottonwood and willow. Over large districts, however, the forest growth is often exceedingly sparse, and even the grass that covers the plains, and upon which travelers depend for the sustenance for their animals, is parched and disappears in the long droughts to which these regions so remote from the sea are subject. In the sandy regions along the North Fork of the Platte River above Laramie River an extraordinary growth of artemisias and other odoriferous plants is found. They abound in the river bottoms and on the hills, growing to the height of two and three feet, in tough, twisted, wiry clumps. A multitude of flowering plants abound in this region, among which prevail several of helianthus (sunflower), and in the month of September, when they are mostly in bloom, the whole country resembles a vast garden. On the western slope may be found some of the largest trees in the world, many of them over 2,000 years old. The vast forests of the Northwest yield enormous quantities of timber. Not only is there a great variety and amount of plant life, but the vegetation attains a remarkable size. The shrub of the Atlantic region becomes a tall tree on the

Pacific Slope. Like the mountains themselves, the vegetation which covers the western slope is large, massive, dense, and in every way, seems patterned on a gigantic scale. (See CALIFORNIA, *Flora*.)

Fauna.—See UNITED STATES

History.—The natural history of a region is told by the geology and physical geography. This region is not as old as the Appalachian. The form of the peaks and the irregular surface of the slopes differ. The missionary explorers visited the mountainous sections of Mexico and the southwestern part of the United States in the 17th century, but the 'Relations of the Franciscans' have as yet (1904) been only partially translated. A large part of our knowledge of this section came first from the reports of the Government explorations made by Lewis and Clark, in 1804. Other explorations were made by Harmann, Long, Schoolcraft, Bonneville, Nicollet, and Fremont (q.v.). Since 1844 more than 20 expeditions have been engaged in exploring these wild regions, nearly all of them for the United States Government. Since the bill and appropriations of March 1853, the object of most of them has been the determination of the most practicable route for a railroad from the valley of the Mississippi to the Pacific. The history of the railroads across these mountains is largely a history of this region. The story of the strange, weird people called Cliff Dwellers (q.v.) is a most interesting chapter in the history of the efforts of man to use this region for a home. At present the population of this whole section is small. A large portion has less than two inhabitants to the square mile. About one tenth of the whole Rocky Mountain area in the United States has from two to six inhabitants to the square mile; in some places in California, Oregon, and Washington there are from six to eight; near the cities from 18 to 45, and in the San Francisco section, from 45 to 90.

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Rococo, rō-kō'kō, or **Rocaille**, rō-kāl-ē', in architecture a name given to the very debased style and decoration which succeeded the first revival of Italian architecture. It is ornamental design run mad, without principle or taste. The ornament consists of panels with their moldings broken or curved at the angles, and filled with leafage, shell-work, musical instruments, marks, etc. This style prevailed in Germany and Belgium during the 18th century and in France from the time of Henry IV. to the Revolution.

Rod, rōd, **Edouard**, Swiss author: b. Nyon, Canton Vaud, 31 March 1857. He studied at Lausanne and Berlin, became editor of the 'Revue Contemporaine' at Paris, succeeded Monnier in the chair of comparative literature at Geneva, but subsequently returned to Paris, and

became a collaborator on the 'Correspondant,' the 'Revue des Deux Mondes,' and other periodicals. Among his works of fiction and criticism are: 'La Course à la Mort' (1886); 'Les Trois Cœurs' (1890); 'Le Silence' (1894); 'Scenes de la Vie Suisse' (1896); 'Au Milieu du Chemin' (1900); 'Dante' (1891); 'Stendhal' (1892); and 'Essais sur Goethe' (1898). Rod has visited the United States as lecturer before the Cercle Français de l'Harvard.

Rod, called also a pole, or perch, a measure of length, equivalent to $5\frac{1}{2}$ yards, or $16\frac{1}{2}$ feet. See PERCH; WEIGHTS AND MEASURES.

Rodakowski, rō-dā-kōv'skē, **Henryk**, Polish artist: b. Lemberg 1823. He studied art in Paris under Cogniet and finally settled there. His works consist of historical pieces, genre, and portraits, the latest being the best. He received medals in 1852 and 1855 and was made chevalier of the Legion of Honor in 1861. He painted the portraits of Gen. Dembinski (1852); Artist's Mother (1853); Prince Saieha; Count Raczyński (1859). Among his historical pieces are 'Sigismund Sanctioning Privileges of Nobility' (1872); 'War Without Fight'; 'Galician Peasants at Church' (1857); 'Battle near Choczyn in 1673'; 'King Sobieski Receiving Envoy from Vienna' (1861).

Rodbertus, Johann Karl, yō'hän kārī rōd-bēr'toos, German political economist: b. Griefswald 12 Aug. 1805; d. Jagetzow 6 Dec. 1875. In 1829-32 he was in the Prussian civil service. In 1848 he entered his brief political career, as a member of the Prussian national assembly. Then he was for a fortnight minister of education, and in January, 1849, entered the second chamber from Berlin. Rodbertus was the real founder of scientific socialism in Germany. In contradistinction to Marx (q.v.), above whom he is placed by many modern economists, he was not international nor material in his views, but a nationalist and idealist, and expected social questions to be solved by legal methods. Prof. Wagner has called him "the most distinguished theorist of the purely economic side of scientific socialism." He wrote several works in connection with his propaganda. Consult the lives by Dietzel (1886-7) and Jentsch (1899).

Rodd, Sir James Rennell, English diplomat and poet: b. 9 Nov. 1855. He was educated at Haileybury College and Oxford University, and entered the diplomatic service as attaché in 1883. He was attaché at Berlin in 1884, and at Athens in 1888, 2d secretary to Rome in 1891 and to Paris in 1892, secretary of legation at Cairo 1894-1901, and secretary of the English Embassy at Rome from 1901. In prose he has published 'Frederick: Emperor and Crown Prince'; 'Customs and Lore of Modern Greece'; and in verse 'Poems in Many Lands'; 'Feda and Other Poems'; 'The Unknown Madonna'; 'The Violet Crown'; 'Ballads of the Fleet.'

Rodenberg, rō'dēn-bērg, **Julius**, German poet: b. Rodenberg, Hesse-Nassau, 26 June 1831. He came of a Jewish family of the name of Levy, but adopted the name of his birthplace for his own. He was educated at the universities of Heidelberg, Göttingen, and Berlin, afterward devoting himself to literature and traveling, and since 1874 has been editor of the 'Deutsche Rundschau.' His publications include: 'Jour-

nalistic Life in London' (1859); 'Pictures of Berlin Life' (1885-8); fiction, 'The New Deluge' (1865); 'The Grandidier' (1878); etc.

Rodenbough, rō'dēn-bow, **Theophilus Francis**, American army officer: b. Easton, Pa., 5 Nov. 1838. He was educated at Lafayette College, and in 1861 was appointed second lieutenant in the United States army. In the peninsular campaign of 1862 he was captured at Manassas, but was soon exchanged, and at the battle of Gettysburg was in command of a regiment. He was engaged at Winchester, losing an arm in that battle, and was brevetted major for his bravery. In 1865 he was brevetted brigadier-general of volunteers, mustered out of the volunteer service, and was appointed major in the regular army. In 1870 he was retired with full rank as colonel. He was secretary of the Military Service Institution in 1879, its vice-president in 1890-1, assistant inspector-general of New York in 1880-3, and in 1890-1901 chief of the bureau of elections in New York. He has written: 'From Everglade to Cañon with the Second Dragoons' (1875); 'Afghanistan and the Anglo-Russian Dispute' (1886); 'Uncle Sam's Medal of Honor' (1887); 'Sabre and Bayonet' (1897); etc.

Roden'tia, or **Glires**, an extensive order of Mammalia, represented by such forms as mice, beavers, porcupines, squirrels, rabbits, lemmings, etc. Of the characteristics tooth structures are the most important. The canines are always absent and the incisors large and chisel-like, and, with the exception of the *Leporida*, which have four in the upper jaw, never more than a single pair in each jaw. These teeth consist each of a front layer of hard enamel and a posterior part of softer dentine, which ensures a persistent sharp edge, since the more rapid wearing of the softer dentine leaves the harder enamel of the front surface as a chisel-like edge. These teeth continue to grow from persistent pulps throughout life. The incisors are long and curved, and each forms a segment of a circle. Between the incisors and the molar teeth a wide interval exists. The molars are few, and their crowns may exhibit a variously laminated or tuberculate pattern. This structure of the molars has relation to the motion of the jaws in gnawing, the jaws being so articulated by narrow condyles fitting in longitudinal grooves that they slide backward and forward instead of moving vertically, as in most other animals. The transverse ridges of the molar teeth act therefore in opposition to this sliding motion of the jaws. The molars in some cases (as in the beavers) also grow from persistent pulps and possess undivided fangs. There is always a succession of milk and permanent dentitions. The chief chewing muscle is the masseter, which is greatly developed, while the temporal muscle is small.

The usual number of toes is five on both feet, but the pollex may be rudimentary or absent, and in the hind feet the number may be reduced to four, as in the hares, or to three, as in the agouti, jerboa, etc. Generally they are all clawed, but sometimes, as in the capybara, have hoof-like terminations. The scapula is narrow and remarkable for the long acromion process, and the clavicles are generally well developed, but may be imperfect or absent, as in the hares and guinea-pig. The femur generally possesses

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a third trochanter, and the tibia and fibula are distinct or, as in the rats and hares, united. The beaver has the hind feet webbed, to adapt it for its semi-aquatic life. Some rodents have the hind legs of extreme length, as the jerboas. Usually a more or less complete hairy screen extends across the mouth at the narrow region of the palate behind the incisor teeth, thus preventing the entrance into the hinder portion of the mouth of the chips or dust that result from gnawing operations. Many rodents are provided with cheek-pouches for carrying food; usually these open within the mouth, but in the *Geomyidae* they open externally.

The stomach, generally a simple structure, may in some forms, as the lemmings, become quite complex, and its anterior portion as in beavers, may be provided with glandular appendages. This same portion in the dormouse is glandular and dilated so as to resemble the proventriculus or digestive stomach of birds. A large sacculated cæcum generally exists, and the intestine is usually very long. A gall-bladder is sometimes wanting. The surfaces of the cerebral hemispheres are smooth or destitute of convolutions, and, when viewed from above, the cerebellum is seen to be in great part uncovered by the cerebrum. The corpus callosum is well developed. The penis is usually retractile and contains a bone, and the testes normally remain in the abdomen, but descend periodically into the groin at the breeding seasons. The uterus is frequently completely divided into two cornua or horns, each of which opens separately into the vagina. In others the two cornua unite to form a single uterus or womb. The placenta is of the deciduate type, and of discoid form. Rodents are extremely prolific. Most species of rodents have characteristic and penetrating odors which arise from scent glands variously located in the vicinity of the anus. The skin, generally covered with hair, is spiny in the porcupines (q.v.), some genera of which group possess prehensile tails. Many of these animals furnish furs of value in commerce.

Extent and Classification.—This is by far the largest order of mammals, comprising more than 2,000 species. Rodents are found in all parts of the world, but are poorly represented in the Australian region and on Madagascar, and are altogether absent from certain oceanic islands. In South America they reach their maximum development. With a very few exceptions, such as the house-rats and the muskrat, they are exclusively herbivorous, and different species subsist upon grains, nuts, bark, roots, herbage, etc. Notwithstanding their great structural similarity the rodents have fitted themselves to the most varied environmental conditions, and present many remarkable adaptations and interesting habits. Most of them are terrestrial; many, like the mole-rats, rabbits, and prairie marmots, are burrowers; some, as the beaver and muskrat, are aquatic; many squirrels and others are arboreal. They run, leap, climb, or, like the flying squirrels and *Anomalurus*, sail through the air on skinny parachutes. Some, as the woodchuck, are solitary; many are gregarious, like the rats and mice, colonial like the rabbit and prairie marmot, or even, like the beaver, form co-operative societies and exhibit wonderful building instincts. Migratory movements of large parties of rodents are not infrequent, the most remarkable of which

are the well-known migrations of the lemmings. Although generally of small size, the rodents have gained a dominance both of species and individuals through their great fecundity and their ability to gnaw out a living beyond the reach of most animals. Their wariness and secretiveness have aided no little toward their preservation, though they form the chief subsistence of a host of snakes, birds of prey, and small carnivorous mammals. Human interests are affected by these animals in a variety of ways. Some of them furnish food, furs, or sport, others are interesting pets, but the great majority are injurious to agricultural interests. No less than 400 species and many additional subspecies have been described as occurring within the limits of North America, the great majority being mice.

The following is a modern classification of the order, though some mammalogists recognize a larger number of families:

GROUP SIMPLICIDENTATA.—There is a single pair of upper incisors with the enamel layer confined to the anterior surface; the fibula does not articulate with the calcaneum. Three sub-orders:

I. *Hystricomorpha*, or porcupine-like rodents: tibia and fibula distinct, alveolus of lower incisor ending on the medial side of the ramus of the lower jaw, only one premolar in each jaw. Families: *Octodontidae*, containing the coryu and many others chiefly of South America, but a few in Africa; *Hystricidae*, the porcupines; *Chinchillidae*, chinchillas of South America; *Dasyproctidae*, agoutis, etc., of South America; *Dinomysidae*, containing a single generalized rodent of Peru; *Caviidae*, the cavies or guinea-pigs and capybara of South America.

II. *Sciuromorpha*, or squirrel-like rodents: tibia and fibula distinct from each other, the alveolus of the lower incisor penetrating the ramus of the lower jaw and the premolars one or two on each side above and one on each side below. Families: *Sciuridae*, the squirrels and marmots, found throughout the world except Australia; *Anomaluridae*, peculiar squirrel-like animals with extensive parachutes along the sides, found in tropical Africa; *Haplodontidae*, *Haplodon*, of the Rocky Mountains; *Castoridae*, the beavers, of the northern hemisphere.

III. *Myomorpha*, or rat-like rodents: tibia and fibula coalesced, lower incisors as in the squirrels, premolars $\frac{3}{4}$ to $\frac{1}{2}$. Families: *Dipodidae*, jumping mice, jerboas, etc., North America, Europe, Asia, and Africa; *Muridae*, the rats and mice, a very extensive and cosmopolitan group which is variously subdivided; *Myoxidae*, dormouse of Europe and other Old World forms; *Geomyidae*, pouched gophers and pouched mice of America; *Lophiomysidae*, a remarkable arboreal African form; *Spalacidae*, the mole rats and their allies of the Old World.

GROUP DUPLICIDENTATA.—Besides the large incisors, the enamel covering of which extends all around, there is a second pair in the upper jaw; the fibula articulates, with the calcaneum and the ankle and elbow joints are tongued and grooved; tibia and fibula co-ossified. One sub-order: *Lagomorpha*, hare-like rodents, with two families: *Leporidae*, hares and rabbits, cosmopolitan; *Lagomysidae*, picas or whistling hares, North America and Europe.

Fossil Rodentia.—Rodent remains first occur in a fossil state in the Eocene Period, in which remains of forms allied to the dormice, porcupines, and squirrels exist. In Pliocene and post-Pliocene formations they become tolerably plentiful. Of the post-Tertiary forms, *Trogontherium*, or the great beaver, found in European deposits, is a familiar species, and the cave beaver (*Castor spelæus*) is also a notable form. *Trogontherium* may possibly have survived the human period. The hares and rabbits first occur as fossils in Lower Miocene of North America and Pliocene of Europe, and the rats and mice are found in Eocene, Miocene, and Pliocene formations. The guinea-pigs are chiefly Pleistocene, their remains occurring in the Brazilian bone caves of that age. Some of the extinct rodents were as large as an ox. Very little light has been thrown on the origin of the order by a study of the fossil forms, though Professor Cope believed the Tillodonts to be their ancestors.

Bibliography.—Consult the articles in this work on the various animals included in the order, and the following: Coues and Allen, 'Monographs of North American Rodentia,' United States Geological Survey of Territories (Washington 1877); Elliot, 'Synopsis of the Mammals of North America,' Field Columbian Museum (Chicago 1901); Beddard, 'Mammals' (London 1902); Alton, 'On the Classification of the Order Glires,' Proc. Zoological Society (London 1876); Woodward, 'Vertebrate Paleontology' (Cambridge 1898); and numerous papers by Merriam, Miller, Palmer, and others in the 'Bulletins' of the Biological Survey of the United States Department of Agriculture.

Roderick, rōd'ēr-ik (Spanish, RODRIGO), last king of the West Goths in Spain. In 710 he was chosen king. Shortly after the Moors, under Muza, invaded Spain. Roderick met the invaders on the banks of the Guadelete in 711, but was defeated, and perished in the battle. Some accounts declare that he maintained resistance for two years longer. He is the hero of Scott's 'Vision of Don Roderick' (1811) and Southey's 'Roderick the Goth' (1814). Consult: Toilhan, 'Chronique Rimée des Derniers Rois de Tolède' (1885); Dozy, 'Geschichte der Mauren in Spanien' (1874); Saavedra, 'Estudio sobre la invasion de los Arabes' (1895).

Rodgers, rōj'ēr-z, Christopher Raymond Perry, American naval officer: b. Brooklyn, N. Y., 14 Nov. 1819; d. Washington, D. C., 8 Jan. 1892. He entered the United States navy as a midshipman in 1833, commanded the schooner Phoenix in the Seminole war in 1840-1, was engaged in blockading service in the Mexican War, and served in the trenches at Vera Cruz and at the capture of Tobasco and Tuspan. He was commissioned commander in 1861, was fleet-captain at the Battle of Port Royal, and also in the attack on the defenses of Charleston in 1863. He was then appointed to command the steam sloop Iroquois and was engaged in special service until the close of the War. He became commodore in 1870, and in 1874 received rank as rear-admiral. He was superintendent of the Naval Academy in 1874-7, in command of the naval forces in the Pacific in 1878-80, and from then until his retirement in 1881 was again superintendent at the academy. He presided

over the convention held in Washington in 1885 for fixing a prime meridian and universal day.

Rodgers, John, American naval officer: b. Harford County, Md., 11 July 1771; d. Philadelphia 1 Aug. 1838. He entered the naval service in 1789, and in 1798, as lieutenant and executive officer of the frigate Constellation, captured a French vessel, for which service he was promoted captain in 1799. In 1802 he was appointed to the Mediterranean squadron then engaged in the war with Tripoli, in the success of which he was largely instrumental. He succeeded Commodore Barron in the command of the squadron in 1805, and in this office rendered a valuable diplomatic service in securing treaties from Tripoli and Tunis which established the friendly relations since existing between those countries and the United States. In 1812 Commodore Rodgers, in command of the Atlantic Squadron, was the first to fire upon the British, and during the campaign captured some 23 English vessels. He was president of the Board of Naval Commissioners 1815-37, except during the three years 1824-7, when he was again in command of the Mediterranean Squadron.

Rodgers, John, American naval officer, son of the preceding: b. Harford County, Md., 8 Aug. 1812; d. Washington, D. C., 5 May 1882. He was commissioned lieutenant in 1840, and was engaged in the hostilities with the Seminoles from 1840 to 1843. Subsequently he performed a valuable service in surveying the Florida coast. His explorations from 1852 to 1861 in the North Pacific and China seas, and in the Arctic Ocean were also of much scientific and commercial importance. As commander of the monitors Weehawken, Dictator, and Monadnock he took a prominent part in the Civil War. He was made commodore in 1863, and in 1869 commissioned rear-admiral in command of the Asiatic fleet. In this office he rendered valuable service as a diplomat by establishing the safety of American commerce in Korea. At his death he was superintendent of the naval observatory at Washington.

Rodin, rō-dān, Auguste, French sculptor: b. Paris November 1840. After working in a subordinate position in several studios he exhibited for the first time in the Salon in 1875, and since then became well known as a sculptor utterly beyond the control of classical convention, and reveling in the first expression of emotion and action, yet showing a power of execution worthy of the best Renaissance art. His statue of Balzac, ordered by the government, was so palpably an attempt to suggest by a plastic achievement something beyond the range of sculptural expression, that it was rejected when exhibited as a cast. Yet he has done some remarkable work, as for instance 'The Brazen Age,' exhibited as a cast, and after much discussion executed in bronze for the Luxembourg Gardens. Among other rugged and fantastic creations are 'Burghers of Calais'; 'The Kiss.' He has made busts of Bastien-Lepage, Victor Hugo, Henri Rochefort, and Jules Daloux, the sculptor.

Rodman, rōd'man, Isaac Peace, American soldier: b. South Kingston, R. I., 18 Aug. 1822; d. Sharpsburg, Md., 30 Sept. 1862. He engaged in business as a woolen manufacturer, served several terms in the Rhode Island legislature and

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in 1861 resigned his seat in the state senate, organized a company, of which he was commissioned captain, and went to the front. He was promoted lieutenant-colonel for gallantry at the first battle of Bull Run, fought at Roanoke Island and at New Berne, N. C., and in 1862 was commissioned brigadier-general of volunteers. He commanded a division at Antietam in 1862 and while leading a charge was mortally wounded.

Rodman, Thomas Jefferson, American military officer: b. Salem, Ind., 30 July 1815; d. 7 June 1871. He was graduated from the ordnance department of West Point in 1841, and was appointed to service at various arsenals, where his experiments in the manufacture of guns soon brought him into prominence. His method of casting guns on a hollow core, the metal being cooled by a stream of water running through the inside, was adopted in 1847. This method he later applied to shells and cannon. In 1860 he completed his experiments upon a 15-inch gun for the uses of mammoth powder, the cannon which bears his name. The Rodman gun and mammoth powder were adopted by the United States government in the following year, and soon after by Russia, England and Prussia. In 1865 he was brevetted brigadier-general, and four years before his death promoted to the rank of lieutenant-colonel.

Rodman Gun. See **ORDNANCE**.

Rodney, rōd'nī, Cæsar, American patriot: b. Dover, Del., 7 Oct. 1728; d. there 29 June 1784. He was the grandson of William Rodney, a large landholder under the Duke of York, in the grant to William Penn, and member of Penn's council. As high sheriff of Kent County and judge of all the lower courts of the Province of Delaware, Cæsar Rodney came into prominence as a statesman. He was a delegate to the Stamp Act Congress held in New York in 1765, and as speaker of that body was largely instrumental in bringing about the first Continental Congress, of which he was also a member. In this capacity he was one of the signers of the Declaration of Independence. In 1775, after the second session of the Congress at Philadelphia, he journeyed through his native province sowing the seed of independence, and was appointed brigadier-general in the army under Washington at the beginning of the Revolution. As commander of the Delaware militia he rendered valuable service, for which he was made a major-general in 1777. In this year also he was made president of the State of Delaware, from which office he retired in 1782.

Rodney, Cæsar Augustus, American statesman, son of Cæsar Rodney (q.v.): b. Dover, Del., 4 Jan. 1772; d. Buenos Ayres, Argentina, 10 June 1824. He was graduated from the University of Pennsylvania in 1789, and after his admission to the bar in 1793 practised law in Wilmington, Del. On account of his election to Congress as an anti-Federalist in 1805 he has been called the first Democrat in that body. In 1807 he was appointed attorney-general of the United States by President Jefferson, but resigned this office in 1811, and in the War of 1812 took active part on the Canadian frontier as captain of artillery. In 1821 he again represented Delaware in Congress, and in the following year took his seat in the United States Senate. In 1823 he was appointed minister plenipotentiary to the Argentine provinces.

Rodney, George Brydges, 1ST BARON RODNEY, English naval commander: b. Walton-upon-Thames, and baptized 13 Feb. 1718; d. London 23 May 1792. He became a lieutenant in 1739, first obtained a ship in 1742 and in 1748 went to Newfoundland as governor. On his return in 1751 he was elected member of Parliament. In 1759 he was promoted rear-admiral, and in 1761 sailed to the West Indies, reduced Martinique and took possession of St. Lucia, Grenada and St. Vincent. In 1762 he became vice-admiral and in 1764 was made a baronet. The next year he became governor of Greenwich Hospital. In 1779, having already been promoted to the rank of admiral, he was put in command of a fleet bound for the West Indies with instructions to relieve Gibraltar on his way. This latter was accomplished on 16 Jan. 1780 by capturing or destroying seven ships of the fleet of the Spanish admiral, Don Juan de Langara. Continuing on to the West Indies he encountered the French fleet under Guichen, near Martinique, with indecisive results, though with considerable loss on both sides. In April 1782, he again met a French fleet in the West Indies, this time commanded by Count de Grasse; and after a three days' fight overcame the French, captured de Grasse and his flagship, the *Ville de Paris*, but forewent the larger part of his spoil by not giving chase. Before the news of the victory reached England, Admiral Hugh Pigot had been sent to supersede Rodney, and though he retired from active service, he was rewarded with a pension and a barony. Consult: Mundy, 'Life and Correspondence of Lord Rodney' (1830); Hannay, 'Rodney' ('English Men of Action').

Rodriguez, rōd-ré'gēs, a volcanic island in the Indian Ocean; about 375 miles east by north of Mauritius (q.v.), of which it is a dependency. It is 18 miles long by 7 miles wide, and the altitude is about 1,750 feet. It is surrounded by a coral reef. Its isolation has prevented change in its flora and fauna, and for this reason the island has been of interest to the botanist and the zoologist. Until near the end of the 17th century the solitary, now an extinct bird, was found on this island. The island was discovered by the Portuguese in 1645, and since 1814 it has been a British colony.

Roe, Charles Francis, American soldier: b. New York 1 May 1848. He was graduated at West Point in 1868 and entered the 1st cavalry, being assigned to frontier duty. In 1870 he was transferred to the 2d cavalry; became 2d lieutenant in 1871 and 1st lieutenant in 1880. In his early days in the West he rode 22½ hours from Camp Harney, Ore., to Fort Bidwell, Cal., to carry orders to prevent an Indian outbreak. In 1888 he resigned from the army and engaged in real estate business in New York. He became major of Troop A, New York Volunteer Cavalry, in 1895, and later was appointed major-general. President McKinley appointed him brigadier-general of United States volunteers in June 1898, but he resigned in the following September.

Roe, Edward Payson, American Presbyterian clergyman and novelist: b. Moodna, New Windsor, Orange County, N. Y., 7 March 1838; d. Cornwall, N. Y., 19 July 1888. He studied at Williams College, and at Auburn and Union theological seminaries; was ordained to the Presbyterian ministry; in 1862-5 was a chaplain

in the volunteer service; and from 1865 until his resignation in 1874 held a Presbyterian pastorate at Highland Falls, N. Y. There his addresses on topics of the Civil War gained for him some notice as a speaker. In 1874 he removed to Cornwall-on-Hudson, N. Y., where he cultivated small fruits and turned out a series of novels which sold largely (759,000 copies, it was estimated, at his death) and met with widespread interest, but quite lacked distinction or literary quality. Among the titles are: 'Barriers Burned Away' (1872); 'Opening a Chestnut Burr' (1874); 'A Knight of the 19th Century' (1877); 'A Face Illumined' (1878); 'Driven Back to Eden' (1885); and 'The Earth Trembled' (1887). He published also three books on horticulture. Consult 'E. P. Roe: Reminiscences of his Life,' by his sister, May Roe (1899).

Roe, Francis Asbury, American naval officer: b. Elmira, N. Y., 4 Oct. 1823; d. Washington, D. C., 28 Dec. 1901. He entered the naval service in 1841 as acting midshipman on the John Adams, and received his later training at the Naval Academy at Annapolis, and in service in various parts of the world. He was executive officer of the flagship Vincennes during the Arctic exploring expedition of 1855, and was made a lieutenant in that year. At the outbreak of the Civil War he was appointed executive officer of the Pensacola, which was in the van of Farragut's fleet, and was especially commended for bravery during the famous passage of Fort Jackson and Fort St. Philip. In 1862 he was ordered to the gunboat Katahdin and upon the first day of his command fought the battle of Baton Rouge. For this service he was promoted to the rank of lieutenant-commander. On 5 May 1864, in command of the Sassacus, he defeated the Confederate ram Albemarle and the gunboat Bombshell near Plymouth, N. C. As commander of the Gulf Division of Rear-Admiral Palmer's squadron at Vera Cruz he rendered noteworthy service as negotiator between the forces of Gen. Juarez and the governor of Vera Cruz, and received the surrender of that city in 1867. From 1869 to 1871 he was with the Asiatic fleet and was commissioned captain in 1872. In 1884 he was promoted rear-admiral and was retired the following year.

Roe, Richard. See DOE, JOHN.

Roe-deer, a small European deer (*Capreolus caprea*), the adult measuring about two feet at the shoulders and about 2½ feet at the hind quarters. The buck's antlers are small, and provided with three short branches only. The general body-color is a brown. The tail has a white patch at its root and the chin, belly and inner aspects of the limbs are grayish-white. These animals inhabit mountainous districts, and are monogamous, each male remaining faithful throughout life to one female. The habits of the roe are somewhat like those of the goat, or even of the chamois. It keeps its footing on rocks with great security, bounds very actively, and takes great leaps. Its usual pace, when not very hard pressed, is, however, a kind of canter. It is not gregarious, not more than a buck and doe with one or two fawns being usually seen together. The voice of the

roe-deer, resembling that of a sheep, but shorter and more barking, is often heard through the night. The roe browses on the tender shoots of trees and bushes as well as on herbage, and is thus very injurious to young woods. It is never very thoroughly tamed, and when kept in parks is apt to become mischievous, and the male dangerous. The venison is superior to that of the stag, but not equal to that of the fallow deer. The horns are used for handles of carving knives and similar articles.

Roebing, reb'ling, John Augustus, American civil engineer: b. Mühlhausen, Prussia, 12 June 1806; d. Brooklyn 22 July 1869. He was graduated at the Royal Polytechnic School in Berlin in 1826, his thesis being on suspension bridges. He came to America in 1831 and settled in Pittsburg, Pa. Later he was engaged in surveying the lines of the Pennsylvania railroad across the Allegheny Mountains from Harrisburg to Pittsburg. Having spent some years thereafter in the manufacture of iron and steel wire he utilized his new product in 1844-5 in building an aqueduct across the Allegheny River at Pittsburg, consisting of a wooden trunk supported by wire cables. The bridge comprised seven spans each 162 feet long. In 1846 he built a suspension bridge over the Monongahela River at Pittsburg, and after building several other bridges removed his business to Trenton, N. J., and in 1851 began the construction of the suspension bridge across Niagara River, connecting the New York Central and the Canadian Railway systems. He next built the bridge over the Allegheny River at Pittsburg and during 1856-67 the bridge connecting Cincinnati and Covington. In 1868 he was chosen chief engineer for the construction of the Brooklyn Bridge; but he died the following year from the effects of an injury to one of his feet. The completion of the structure was carried out by his son. He was the author of 'Long and Short Span Railway Bridges' (1869).

Roebing, Washington Augustus, American civil engineer: b. Saxonburg, Pa., 26 May 1837. He was graduated at the Rensselaer Polytechnic Institute, Troy, N. Y., in 1857, and joined his father, John A. Roebing (q.v.), in the construction of the suspension bridge across the Allegheny River at Pittsburg. He served in the Union army, 1861-5; was brevetted lieutenant-colonel in December 1864 for gallant service before Richmond and colonel of volunteers in March 1865 for meritorious service during the war. He joined his father in building the Cincinnati-Covington suspension bridge and became assistant engineer in constructing the Brooklyn bridge. After his father's death in 1869 the entire direction of the work was left in his hands and the bridge was completed in 1883. Since that date he has been engaged as vice-president of the iron and steel wire and wire rope manufacturing concern of John A. Roebing & Sons Co. of Trenton, N. J.

Roebingite, a white, massive mineral, recently found at Franklin Furnace, N. J., having the remarkable composition $H_{10}Ca_5Pb_5Si_5S_2O_{30}$, which is interpreted by Penfield as being a combination of five molecules of the silicate H_2CaSiO_4 with two molecules of the basic sulphite, $CaPbSO_4$. This is the only known occur-

rence of a sulphite in nature. Named after W. A. Roebing.

Roebuck, rō'būk, John Arthur, English politician: b. Madras, India, 29 Dec. 1802; d. London, England, 30 Nov. 1879. He was called to the bar in 1831. In 1832-7 and in 1841-7 sat in Parliament for Bath, and for Sheffield in 1849-68 and again from 1874 until his death. He defended the Crimean war, favored the Confederacy in the United States, and supported Beaconsfield in his Eastern policy in 1877-8. In 1879 he became a member of the privy council. He wrote: 'Colonies of England' (1849); 'History of the Whig Ministry of 1830' (1852); etc.

Röediger, rē'dīg-ēr, Emil, German Orientalist: b. Sangerhausen, Thuringia, 13 Oct. 1801; d. Berlin 15 June 1874. He studied at Halle, where in 1830 he became extraordinary and in 1835 ordinary professor of Oriental languages. He removed to a similar post in Berlin in 1860 and remained there until his death. He continued the work of Gesenius' 'Novus Thesaurus Philologicus Criticus Linguae Hebraeae et Chaldaee Veteris Testamenti, Editio ii.' with indexes, additions, and corrections (1858). He edited Gesenius' 'Hebrew Grammar,' and wrote 'De Origine et Indole Arabicæ Librorum V. T. Historicorum Interpretationis Libri Duo' (1829).

Roelofs, rē'lōfs, Willem, Dutch painter and naturalist: b. Amsterdam 10 March 1822. He early made his home in Utrecht, where he learned to appreciate the beauty of the Netherlands landscape. In 1845 he began his art career in The Hague and three years later went to Brussels, thus completing his studies of the Dutch masters. From Belgium he passed to France and received the great artistic impulse of his life from the French landscape painters who represent the aspects of nature as interpretative of spiritual moods. Thus he learnt to depict what we may style the transitions of color and light in scenery with a certain dramatic intensity, and preferred the portrayal of dazzling light effects, and violent contrasts in color; as when the sunlight pours like a torrent through gaps of leafage into the dark forest depths. He has traveled through the whole of Holland and gathered subjects and *motifs* for his pictures from many obscure and unfamiliar spots, painting with equal facility in oil and water color. He is also a skilful etcher. As a naturalist he is well known among students of entomology.

Roentgen, rēnt'gēn, Wilhelm Konrad, German physicist: b. Lennep, Prussia, 27 March 1845. He was educated at Zürich; became Kundt's assistant at Würzburg in 1870, and at Strasburg in 1872; was made lecturer at the latter in 1874; and professor extraordinary in 1876. In 1879 he was appointed professor ordinary at Giessen, in 1888 at Würzburg, in 1899 at Munich. He published in the 'Annalen der Physik und Chemie' the results of numerous experimental labors; but he is best known for his discovery in 1896 of the Roentgen rays (see X-RAYS) which proved capable of such wide application in surgery and other fields, and for which he received in 1901 the Nobel prize for physics.

Roga'tion Days, the Monday, Tuesday and Wednesday next before Ascension Day: so called because they are observed as days of solemn supplication, with processions and chanting of the Litanies (Greek, *litaneia*, supplication; equivalent to Latin *rogatio*). The custom of processions on these days had its rise in the city of Vienne in Gaul about the middle of the 5th century, when, the city having been visited with earthquakes, fires, and other grave calamities, the bishop, Saint Mamertus, ordered a solemn fast and public supplication of three days to appease the divine indignation: and thereafter the three days' supplication was practised annually, the custom spreading throughout Gaul and beyond the Alps. Everywhere these processions were suppressed in England after the triumph of the Reformation, yet in some localities the perambulation of the boundaries of parishes on the "gang-days" is said still to be kept up. See also LITANY.

Roger I., count of Sicily: b. Normandy about 1031; d. Mileto, Calabria, 1101. Roger's brothers, Drago, Humphrey, William, and Robert Guiscard, had acquired fame in Italy, and obtained possession of the county of Aversa, when he was summoned thither by his brother, Robert, and landed in Apulia in 1057. The two brothers, Robert, the eldest, and Roger, the youngest, founded the kingdom of the Two Sicilies. Roger in 1063 defeated the Saracens at Ceramium, and was thereupon confirmed by the pope in all his conquests in Sicily. He took the title of Count of Sicily, and in spite of certain disputes between the brothers, the complete subjugation of Sicily was the result of their joint efforts. After the death of Robert Guiscard in 1085 the Norman power in Italy came into Roger's hands. The general support given to him by the pope freed him from many dangers. In 1098 he gave him a free brief (the genuineness of which has, however, been questioned), that he would send no legate to Sicily without Roger's consent, and left it to him to decide what bishops should attend the general assemblies of the Church and whom he should detain for the service of the kingdom. With this extension of his spiritual rights Roger introduced many important improvements. Consult Schack, 'Geschichte der Normanen in Sicilien' (1889).

Roger II., king of Sicily: b. about 1095; d. February 1154, second son of Roger I. His elder brother, Simon, died in 1102, and during his minority the government was administered first by his mother, Adelheid, a daughter of the Margrave Boniface of Montserrat, and then by Prince Robert of Burgundy. The free barons of the land, however, leagued with Pope Honorius II. to break the Norman ascendancy. They had no success, and the pope voluntarily confirmed Roger in the possession of Apulia and Calabria. Pope Anacletus extended the confirmation to Capua and Naples; and in 1130 Roger received the title of king. He now pressed so hard upon the barons that Rainulf of Avellino, Robert of Capua, Servius of Naples, and others revolted, receiving support from the German and Greek emperors, Lothar and Emmanuel, and the influence of the anti-pope, Innocent II., who excommunicated the Sicilian monarch. Roger in 1132 was defeated by them in

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an engagement; but having promptly assembled a new army suddenly recovered all he had lost, and although the revolt lasted till 1136 it terminated to Roger's advantage. He took Malta and the adjacent islands, and afterward made himself master of Tripoli. With a second fleet he sailed to Madia, and took it in 1148. At the same time he led an expedition against the kingdom of Greece, in which he took Corfu and Thebes, and plundered Corinth, Athens, Cephalonia, and Negropont. In 1152 he extended his dominion from Tripoli to Tunis, and from the desert of Mohrab to Kairwan. The peace which followed he turned to good account, reforming the law, introducing order into the administration, and patronizing science. Consult Schack, 'Geschichte der Normanen in Sicilien' (1889).

Roger de Hoveden, English historian: lived in the last half of the 12th century; d. Hoveden, now Howden, East Riding of Yorkshire. He was a lawyer, in holy orders, and lived at the court of Henry II., whom he served in many diplomatic and professional capacities. His latter days were spent as a prebend of the collegiate church at Howden, to which he had retired on the death of his royal master. The history or chronicle which he wrote during his half monastic retirement was based upon 'Historia Saxonum vel Anglorum post Obitum Bedæ' (1101). The main additions made by Roger de Hoveden to this work include: the miracles of Edward the Confessor; an abstract of the charter by which Hominburgh and Brackenholm were ceded by William the Conqueror to Durham; a list of French knights at the siege of Nice. Naturally the most valuable part of the Chronicle is that which relates to the time in which Roger lived (1169-92). Edward I. in 1291 caused diligent efforts to be made to secure a copy of it, that he might collect therefrom evidence bearing on the vexed question as to the homage due the king of England from the Scottish Crown. The Chronicle was first printed in 1696. Consult Morley, 'English Writers' (Vol. III.).

Roger of Wendover, English chronicler: d. 1237. He was a monk in Saint Alban's Abbey, and lived to be prior of Belvoir. His chronicle extends from 1189 to 1235, and bears the title 'Flores Historiarum' in the 'Historia Major.' His collaborator was John de Cellis, and the work was continued by Matthew of Paris. Consult Morley, 'English Writers.'

Roger Williams University, an institution for the education of the colored race at Nashville, Tenn. It was established in 1863 by the Baptist Home Mission Society. Its work is in three grades, elementary, secondary, and collegiate; a classical, a scientific, an English, and a normal course are offered; there is also provision for professional instruction and for industrial training in printing, sewing, etc. The institution is supported by the Baptist Home Mission Society and by tuition fees; there is no endowment; the income in 1903 amounted to \$9,400; the grounds and buildings were valued at \$150,000; and the library contained 6,000 volumes. The students number about 250, and the professors and instructors 14.

Rogerenes, rōj'ēr-ēnz, **The**, the name given a former evangelical sect at New London,

Conn. They were of non-resistant principles, and were resolutely opposed to any dictation regarding religious observances, aside from the teachings of the New Testament.

Rogers, rōj'ēr-z, Fairman, American civil engineer: b. Philadelphia 15 Nov. 1833; d. Vienna, Austria, 23 Aug. 1900. He was graduated from the University of Pennsylvania in 1853, was lecturer on mechanics at Franklin Institute, Philadelphia, in 1853-65, and professor of civil engineering at the University of Pennsylvania 1855-70. He was a volunteer in the Union army in 1861 and completed the survey of the Potomac River northward from Blakiston Island in 1862. He was a trustee of the University of Pennsylvania in 1871-86, presented to the university a valuable library of works on engineering in 1878, and finally resigned his trusteeship because of continued residence abroad. Besides various valuable scientific papers he wrote: 'Terrestrial Magnetism and the Magnetism of Iron Ships' (1883); and 'Manual of Coaching' (1900).

Rogers, Henry, English Congregational clergyman and essayist: b. St. Albans 18 Oct. 1806; d. Pennal Tower, Machynlleth, Wales, 20 Aug. 1877. He studied at Highbury College and became a Congregationalist minister at Poole, Dorsetshire, in 1829. Three years later he was appointed lecturer on rhetoric and logic in Highbury College, and in 1836 became professor of English language and literature in University College, London. He was made professor of English language and literature and mental philosophy in Spring Hill College, Birmingham, in 1839, and held that post till 1858 when appointed principal and professor of theology in the Lancashire Independent College. From 1839 he contributed regularly to the 'Edinburgh Review,' some of his contributions to that periodical being collected in 'Essays Critical and Biographical' (1874), and 'Essays on Some Theological Controversies' (1874). His chief work, 'The Eclipse of Faith,' a piece of skilful dialectics, was published anonymously in 1852, being followed by a 'Defence of the Eclipse of Faith' (1854), in which he replied to F. W. Newman's reply to his earlier work.

Rogers, Henry Darwin, American geologist: b. Philadelphia 1 Aug. 1808; d. near Glasgow, Scotland, 29 May 1866. He was appointed professor of physical sciences at Dickinson College, Carlisle, Pa., in 1830, studied in London in 1831, was lecturer on geology at Franklin Institute in 1833-4, and in 1835-46 was professor of geology and mineralogy at the University of Pennsylvania. In 1835 he made a geological survey of the State of New Jersey, and was appointed geologist in charge of the survey of Pennsylvania in 1836. The survey was interrupted in 1841-51 by lack of appropriations, and Rogers was engaged as an expert for various coal companies, until he resumed the survey which was then concluded in 1854. The final report of the survey was entrusted to him, and he completed the work in Edinburgh. From 1857 until his death he was professor of geology and natural history at the University of Glasgow. He published: 'Description of the Geology of the State of New Jersey' (1840); 'The Geology of Pennsylvania, a Government

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Survey' (1858); numerous geological reports, etc.

Rogers, Henry H., American capitalist: b. Fairhaven, Mass. He was educated in the schools of his native town, and afterward became connected with the Standard Oil Company, of which he is at present a large stock-holder and a vice-president. Of the great wealth acquired through his numerous business enterprises he has devoted large sums to public and benevolent uses, especially for the benefit of Fairhaven. Among his gifts to the town are two schools, a town hall, the Millicent Library (a memorial to his deceased daughter), a Masonic building, and memorial church buildings, comprising a group said to be excellent examples of Tudor architecture, the church itself being perhaps the finest of its size ever built in America. These buildings were erected in memory of the giver's mother. He has also built at Fairhaven, and presented to the Millicent Library, a system of waterworks from which it derives an income; and as superintendent of streets he has made, presumably in great part at his own expense, vast improvements in the public highways.

Rogers, Henry J., American inventor: b. Baltimore, Md., 1811; d. there 20 Aug. 1879. He is known as the inventor of a code of flag signals, adopted by the United States in 1846, and was also the originator of a code of signals in which colored lights are used. As an associate of Samuel F. B. Morse (q.v.) he was instrumental in constructing the first telegraph line, and was the inventor of several important telegraphic instruments, and was one of the organizers of the first telegraph companies in the United States, the Magnetic Telegraph Company, established in 1845. He served in the Civil War as acting master of the volunteer navy. Subsequently he was prominently identified with the American, the Bankers' and Brokers', the Southern and Atlantic, and the Western Union Telegraph companies. His writings include: 'The Telegraphic Dictionary and Seaman's Signal Book' (1845); 'The American Code of Marine Signals' (1854); and, in collaboration with W. F. Larkins, 'Rogers' Commercial Code of Signals for All Nations' (1859).

Rogers, Henry Wade, American lawyer: b. Holland Patent, N. Y., 10 Oct. 1853. He was graduated at the University of Michigan in 1874 and was admitted to the bar in 1877. In 1883 he became professor in the law school of the University of Michigan and was its dean from 1885 to 1890. From 1890 to 1901 he was president of Northwestern University, and in the latter year became connected with the Yale Law School, where he is at present dean. He has written: 'Illinois Citations' (1881), and 'Expert Testimony' (1883).

Rogers, Howard J., American educator: b. Stephentown, N. Y., 16 Nov. 1861. His early education was obtained in public schools and at the Pittsfield, Mass., High School; after graduating in 1880 he entered Williams College, from which he was graduated A.B. in 1884. He was admitted to the New York State Bar in 1887. From 1884-92 he was teacher of history and literature in the Albany Boys' Academy; superintendent of the New York State Educational Exhibit at the World's Columbian Exposition, Chicago, 1892-4; acting-secretary of the

New York Commission there, and editor of the official report of the commission, 1894-5; Deputy-Superintendent of Public Instruction, New York State, 1895-1901; Director of Education and Social Economy for the United States Commission at the Paris Exposition of 1900. At the St. Louis Exposition, 1904, he was Chief of the Departments of Education and of Social Economy, and also Director of Congresses and editor of the Proceedings of the International Congress of Arts and Sciences. In April, 1904, he became First Assistant Commissioner of Education of the State of New York, having charge of Higher Education. He was decorated, in 1901, by the French Republic with the Order of the Legion of Honor of France, and promoted to the rank of *officier* in 1904; in 1904, by King Victor Emanuel III. of Italy, with the Order of Chevalier of Saint Maurice and Lazare; by King Oscar II. of Sweden, with the Order of the North Star; and in 1905, by Emperor William II. of Germany, with the Order of the Red Eagle, rank of officer, and by King Leopold II. of Belgium with the Royal Order of Leopold.

Rogers, Jacob S., American manufacturer: b. Paterson, N. J., 1823; d. New York 2 July 1901. In 1856 he became head of the Rogers Locomotive and Machine Works of Paterson. He retired from active business in 1897, and upon the completion of outstanding contracts closed the works 1 Dec. 1900. He bequeathed the bulk of his estate to the Metropolitan Museum of Art, New York. Litigation was begun by other legatees, but a settlement was effected by the payment to these of \$250,000. The residuary estate, about \$5,000,000, went to the museum.

Rogers, James Edwin Thorold, English economist: b. West Meon, Hampshire, 1823; d. Oxford 12 Oct. 1890. He was educated at King's College, London, and at Oxford, took orders in the Established Church, and appointed curate of St. Paul's, Oxford. After 1860 he lost sympathy with the Tractarian movement and in 1870 was the first to take advantage of the new Clerical Disabilities Relief Act to resign his orders. He received the Tooke professorship of statistics and economic science at King's College, London, in 1859. In 1862 he was elected for five years Drummond professor of political economy at Oxford, but failed of reelection at the end of that term on account of his advanced religious views. He was again elected to the chair in 1888, however, after the death of Bonamy Price, who had held the post in the interval. In 1880 he entered Parliament for Southwark and in 1885 was elected for Bermondsey; but his adoption of Gladstone's home rule policy in 1886 lost him his seat in the general election of that year. His great work is his 'History of Agriculture and Prices in England' (1866-93), covering the period from 1259 to 1793. Based upon this was his 'Six Centuries of Work and Wages' (1884).

Rogers, James Guinness, English Congregational clergyman: b. Enniskillen, Ireland, 29 Dec. 1822. He was educated at Trinity College, Dublin, and at Lancashire Independent College. He held his first charge at Newcastle-on-Tyne in 1846-51, was pastor at Ashton-under-Lyne 1851-65, and from the last-named date until 1902 was minister of the Clapham Congregational Church in London. He has published: 'Priests and Sacraments' (1870); 'Present Day Religion and Theology' (1887); 'Christ for the

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World' (1895); 'The Christian Ideal' (1898); etc.

Rogers, John, English Reformed clergyman, first martyr in the Marian persecution: b. Deritend, Aston parish, near Birmingham, about 1500; d. London 4 Feb. 1555. He obtained his education at Cambridge, in 1532-4 was rector of Trinity the Less, London, and then went to Antwerp as chaplain to the English merchants there. There, it is said, he was led by William Tindal, then busy on the translation of the Old Testament into English, to change his religious views. He then took charge of a Protestant congregation at Wittenberg, and prepared for the press an English rendering of the Bible, including Tindal's New Testament, and Old Testament as far as the end of 2 Chronicles. His part in the translation was slight, but his marginal notes formed the earliest English commentary on the Scriptures. The whole constituted the second complete version in English, Coverdale's having appeared in 1535, while this appeared, with the pseudonym "Thomas Matthew" on the title-page, in 1537. In 1548 Rogers returned to England, in 1550 was simultaneously made rector of St. Margaret Moyses, London, and vicar of St. Sepulchre there. In 1551 he received the prebend of St. Pancras in St. Paul's cathedral. In 1553 he preached twice at Paul's Cross, the second time against Catholicism (6 August), three days after Queen Mary's arrival in London. He was shortly deprived of the emoluments of his benefices, on 27 Jan. 1554 imprisoned at Newgate at the instance of Bonner, new bishop of London, and after two examinations (22, 29 January), was burned at the stake at Smithfield; showing, says Fox, "most constant patience, . . . exhorting the people constantly to remain in that faith and true doctrine which he before had taught." Consult Fox, 'Book of Martyrs'; and the biography by Chester (1861).

Rogers, John, American sculptor: b. Salem, Mass., 30 Oct. 1829; d. New Canaan, Conn., July 1904. In early life he developed a talent in clay modeling; and in 1858 went to Europe where he studied under the best masters in Paris and Rome. He returned to the United States in 1859, and modeled a large number of statuettes, of which his first group, 'The Checker Players,' attracted popular attention. Many of these "Rogers Groups" pertained to the Civil War and elicited general popular approval rather than the unstinted admiration of the art critic. He also executed the equestrian statue of Gen. Reynolds, now at the city hall in Philadelphia.

Rogers, Randolph, American sculptor: b. Waterloo, N. Y., 6 July 1825; d. 15 Jan. 1892. He studied art in Europe from 1848 to 1850 when he returned to the United States, where he executed a statue of Bulwer's blind heroine 'Nydia' and a figure of President John Adams. He for five years had a studio in New York, but established himself in Rome in 1855. In 1858 he began the bronze doors for the Capitol at Washington and subsequently executed several portrait statues and memorial monuments in Providence, Richmond, Detroit, and other cities. His colossal figures of Gens. Lewis and Nelson, for the Washington monument, which Crawford had begun to raise near Richmond, are good specimens of his work. Among his other statues

is that of Seward in Madison Square Park, New York. Perhaps one of his best works is the figure of the 'Resurrection Angel' for the tomb of Col. Colt in Hartford, Conn.

Rogers, Robert, American author and soldier: b. Dunbarton, N. H., 1727; d. England about 1800. He raised a company of soldiers known as "Rogers' Rangers" and commanded them efficiently during the French and Indian War of 1755-63. He visited England in 1765 and was appointed governor of Mackinaw, Mich., but while holding this office was charged with designs for delivering his own fort to the French and was sent to Montreal in irons. At the outbreak of the American Revolution he declined a commission in the Colonial army, though professing a sincere interest in the cause of the colonies, and later aroused the suspicions of Washington. He was secured but was released on parole, which he broke, accepted a commission in the British army and organized the "Queen's Rangers," recruits to which he promised their "proportion of rebel lands." Shortly after 1776 he went to England. He was proscribed and banished by the provincial government of New Hampshire in 1778. Further traces of his life are lacking. He wrote: 'A Concise Account of North America' (1765); 'Ponteach, or the Savages of America,' a tragedy in verse, now very rare (1766); and 'A Diary of the Siege of Detroit in the War with Pontiac,' first published in 1860.

Rogers, Robert Cameron, American poet: b. Buffalo, N. Y., 7 Jan. 1862. He was graduated from Yale in 1883, and has since published 'Wind in the Clearing and Other Poems'; 'For the King and Other Poems'; and in prose, 'Will o' the Wisp,' a sea tale; and 'Old Dorset: Chronicles of a New York Country Side.'

Rogers, Samuel, English poet: b. Stoke-Newington, London, 30 July 1763; d. London 18 Dec. 1855. After completing his attendance at private school he entered the Rogers banking establishment as a clerk, but his favorite pursuits were poetry and general literature. He went, on one occasion, to pay in person his respects to Dr. Johnson; but hurried away in dread of raising the knocker. In 1786 he printed anonymously 'An Ode to Superstition, with Some Other Poems.' His 'Pleasures of Memory,' with which his name is principally identified, appeared in 1792. It is a carefully finished and graceful production, but somewhat deficient in force and vigor, and though every one is familiar with the name, the 'Pleasures of Memory' is a poem that at the present day is comparatively little read. It was received with unbounded applause, and the reputation of the author was still further confirmed by the publication in 1798 of 'An Epistle to a Friend and Other Poems.' He now built the celebrated house in St. James' Street, Westminster, which he had in part decorated by Stothard and Flaxman; filled with antiques, books, and art-works, all selected in admirable taste; and long made the centre of intellectual society. It ought also to be recorded that, though possessed of much surface brusqueness, and bitter of tongue, no man was more generous in relieving distress or assisting struggling genius; and Sheridan, Moore, Campbell, and others, were all indebted

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at different times to his generous liberality. He published in 1810 his poem of 'Columbus,' which was severely handled by the 'Quarterly Review,' and met with little success. 'Jacqueline, a Tale,' appeared in 1814, in the same volume with Lord Byron's 'Lara.' The same year he visited Paris, extending his tour to Italy, and remained abroad for several years. On his return in 1819 he published the poem of 'Human Life,' and in 1822 appeared the first part of his 'Italy,' a series of poems descriptive of the scenery and antiquities of that country, and perhaps the finest of all his works. Continuations of it followed at successive periods, and a complete edition in 1830, beautifully illustrated by Prout, Stothard, and Turner, which, with an illustrated edition of his other poems, composes two 8vo volumes, and was issued at a large outlay to the author. It proved, however, a remunerative speculation. In 1850 Rogers was offered the laureateship, vacated by the death of Wordsworth, but declined the appointment, which was bestowed on Tennyson. His unique collection of works of art was disposed of by auction after his death. Rogers' long life saw many literary changes, from the times of Goldsmith and Johnson to those of Thackeray and Dickens. He was a kind of English "autocrat of the breakfast table"; famous for his anecdotes and bon-mots, and his discussions of politics and art. He was certainly a representative, though among the less prominent, of a brilliant period of English poetry; with him care and taste served for genius. A volume of his 'Table Talk' was published by Alexander Dyce (1860). Consult Clayden, 'Early Life of Samuel Rogers' (1887), and 'Rogers and His Contemporaries' (1889). The correspondence, journals, and memoirs of the earlier 19th century abound in references to him.

Rogers, William Augustus, American astronomer: b. Waterford, Conn., 13 Nov. 1832; d. Waterville, Maine, 1 March 1898. He was graduated from Brown University in 1857, engaged in teaching at Alfred University and in 1858 accepted its chair of mathematics and astronomy. In 1864-5 he served in the United States navy and in 1866-7 studied at Yale, but resumed his duties at Alfred after each interruption, and under his direction the observatory there was built and equipped. He was appointed assistant at the Harvard Observatory in 1870 and became assistant professor of astronomy in 1877. He accepted the chair of astronomy and physics at Colby University in 1886 and remained there until his death. His work at Harvard Observatory consisted of observing and mapping all the stars down to the 9th magnitude, in a narrow belt a trifle north of our zenith, a task which consumed 11 years in observations and 15 years for their reductions. He overcame the difficulty of finding micrometer spiderwebs suitable for his work by etching glass plates with hydrofluoric acid, an expedient which proved so successful that he furnished the government with the plates used by the expedition to observe the transit of Venus. He was an acknowledged authority on micrometrical work and established standards of measurement for practical mechanical work.

He was an active member of various scientific societies and published nearly 70 papers concerning his specialties. He also published, in the 'Annals of Harvard Observatory': 'Observations made with Meridian Circle, 1871-2'; 'Catalogue of 8,627 Stars Between 49° 50' and 50° 10' of North Declination, 1875'; 'Journal of Zone Observations During the Years 1875-1883'; etc.

Rogers, William Barton, American geologist and physicist: b. Philadelphia 7 Dec. 1804; d. Boston 30 May 1882. He was educated at William and Mary College, gave scientific lectures before the Maryland Institute in 1827, and in 1828 became professor of natural philosophy and chemistry in William and Mary College. From 1835 until his resignation in 1853 he was professor of natural philosophy in the University of Virginia. He added to the course mineralogy and geology; and organized and directed the Virginia geological survey until its discontinuance in 1842. During his occupancy of this chair he devoted much of his time to original researches in geology, chemistry, and physics. He was also a leading member of the Association of American Geologists and Naturalists (organized 1840), and to its 'Transactions' contributed important memoirs, including observations on the temperature of coal mines in eastern Virginia. In 1853 he removed to Boston, where he continued his researches and voluminous contributions to scientific journals of the United States and Europe, and in 1862 lectured before the Lowell Institute on "The Application of Science to the Arts." At the request of several citizens of Boston, he drew up in 1859 a scheme entitled "Object and Plan of an Institute of Technology," to include a society of arts, a museum of arts, and a school of industrial science. He then memorialized the State legislature, and at length obtained from the State a charter (1862), and the grant of a tract in the Back Bay district upon which to place the buildings of the institution. Chosen the first president of the Massachusetts Institute of Technology, he was made also professor of physics and geology, and in 1864 visited Europe for the purchase of scientific instruments and appliances. He organized the system of teaching which still in general obtains in the Institute, and whose leading feature was laboratory instruction not only in chemistry, but in physics, mechanics, and mining. He resigned his post as president in 1870, but resumed his duties from 1878 to 1881, when he was succeeded by Francis A. Walker (q.v.). In 1847 he presided at the meeting by which the Association of American Geologists and Naturalists was enlarged into the American Association for the Advancement of Science; was made president of the latter in 1875; was a corporate member of the National Academy of Sciences; became its president in 1878; and was a founder and the first president of the American Social Science Association. He has been characterized as one who had in a high degree "the faculty of presenting the claims of science on popular interest and respect with force and lucidity." His gifts of expression as speaker and writer were excellent. Many of his researches added materially to scientific knowledge. Among his books were

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'The Strength of Materials' (1838); 'The Elements of Mechanical Philosophy' (1852); and 'Papers on the Geology of Virginia' (1884), comprising his yearly reports in 1836-40. Consult the 'Life and Letters,' published in 1897.

Rogersville, rōj'érz-vil, Tenn., village, county-seat of Hawkins County; on the Southern railroad; about 45 miles east-northeast of Knoxville. It is in a fertile valley, bordered by mountainous regions rich in variegated marble, and building stone, and having considerable coal. The chief manufacturing establishments are flour mills, furniture factories, and machine shops. A number of the villagers have employment in the marble quarries. The educational institutions are the McMinn Military Academy, and the Swift Memorial Institute. The latter was founded in 1848 by the Presbyterian Church. There are good public schools and two school libraries. The national bank has a capital of \$75,000. Pop. (1910) 1,582.

Rogersville, Engagements at. On 5 Nov. 1863 Col. Israel Garrard, with the 7th Ohio cavalry, 2d Tennessee mounted infantry, and a battery of four guns, occupied Rogersville, Tenn., camping near the town. During the day Gen. W. E. Jones, with about 2,500 Confederate cavalry, crossed the Holston River near Kingsport, made a night march by roads badly guarded, and at daybreak of the 6th surprised and captured Garrard's outposts, and advanced towards his camp, attacking and routing the 7th Ohio, Garrard and a few of his men escaping to Morristown. Jones then attacked the Tennessee regiment, which made a good resistance, but was soon surrounded and obliged to surrender. The Union loss was about 20 killed and wounded, and 650 men, four guns, two colors, 1,000 horses and mules, and 40 wagons and ambulances captured. The Confederate loss, as reported, was 10 killed and wounded. News of the disaster caused a hasty retreat of the Union forces from Jonesboro and Greeneville to Bull's Gap, where it was learned that Jones had not advanced beyond Rogersville, and the retreat ended. At the same time Jones retreated in an opposite direction to the Virginia line.

On 21 Aug. 1864 Rogersville was held by a small force of Confederate cavalry, under Col. Watkins, which was attacked at daybreak by a detachment of the 13th Tennessee cavalry, under Lieut.-Col. Ingerton. Several Confederates were killed and wounded, and Watkins, with 25 of his men, captured, the remainder escaping to Kingsport. On 8 Oct. 1864 Gen. John C. Vaughn, having driven a Union force from Kingsport, followed it to Rogersville, and attacked with his brigade, killing 10 and wounding several Union troops, and driving the remainder to Bull's Gap. On 10 December Gen. A. C. Gillem, with a Union brigade, marched from Knoxville, on the 12th drove in the pickets of Gen. Duke's brigade, and followed to Big Creek, four miles from Rogersville, where the Confederates had taken a strong position. With a part of his command Gillem made a flank movement, charged with the other part, and drove the Confederates from position and through Rogersville, in the direction of Kingsport, where they were overtaken next day and

routed, with some loss. Consult: 'Official Records' Vols. XXXI, XXXIX., and XLV.

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Roget, rō-zhā', Peter Mark, English physician: b. London 18 Jan. 1779; d. Malvern, Worcestershire, 12 Sept. 1869. He was educated at the University of Edinburgh and was appointed physician to the Manchester Infirmary in 1804. In 1808 he removed to London, where he became physician to the Northern Dispensary. He was elected a fellow of the Royal Society in 1815 and for 20 years served as its secretary. He was professor of physiology at the Royal Institute in 1833-6, and in 1837 was active in the establishment of the University of London, in the senate of which he continued a member until his death. He retired from practice in 1840 and devoted himself to literature and to mechanics, for which he had decided talent. He wrote: 'Animal and Vegetable Physiology Considered with Reference to Natural Theology' (1834); 'Physiology and Phrenology' (1838); and the famous 'Thesaurus of English Words and Phrases' (1852).

Roggeveld (rōg'gē-vēld) Mountains, in Africa, in the southwestern division of Cape Colony, running northwest to southeast with an average height of 5,000 feet. They form a western continuation of the Nieuwveld Mountains.

Rogier, rō-zhē-ā, Charles Latour, Belgian statesman: b. St. Quentin 17 Aug. 1800; d. Brussels 27 May 1885. He was educated at the University of Liège and at the outbreak of the Belgian revolution in September 1830 became a revolutionary leader in Brussels. On 24 September he was made president of the administrative commission and later went as a delegate of the provisional government to Antwerp. After an armistice had been arranged with Holland, he exercised absolute power in the reorganization of the administration of the city. He represented Liège in the National Congress, voted to establish a hereditary monarchy, and proposed the adoption of the elective second chamber. He became governor of the province of Antwerp in 1831 and the next year minister of the interior. He retired in 1834 after having carried a law providing for the establishment in Belgium of the first railway in Europe. From 1834 to 1840 he was again governor of Antwerp; and leader of the Liberal party in opposition 1841-7. He became prime minister and minister of the interior in 1847 and by his energy and foresight Belgium escaped the revolutionary crisis that involved Europe in 1848. In 1850 he organized secondary education under control of the state; but retired from office in 1852. Again becoming prime minister in 1857 one of the first acts of his ministry was the fortification of Antwerp. In 1861 he became minister of foreign affairs and succeeded in freeing the navigation of the Scheldt, which fact contributed to make Antwerp one of the important ports of Europe. He retired from ministerial office in 1868, though he sat for Tournai until his death.

Rogue Money, the popular name for an assessment formerly levied on every county in Scotland "for defraying the charges of apprehending criminals, or subsisting them when apprehended, and of carrying on prosecutions against them." This tax was first imposed by

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a statute of George I., on the assertion that criminals were in the habit of escaping punishment for lack of the funds necessary to bring them to justice. The freeholders in each shire were directed to fix the assessment at any of the head courts yearly, and to appoint collectors. By an act of Victoria rogue money in the shires was abolished, and in lieu thereof power was conferred on the Commissioners of Supply to levy by rate a "County General Assessment."

Rogue (rōg) River Indians, the name applied to a number of Indian tribes on Rogue River, southwestern Oregon, most of which belonged to the Athapascan stock, but the members of the Takilman stock were also included. They were not friendly to the early settlers, and in 1853, with neighboring tribes, finally resented the continued encroachments on their lands by conducting a succession of massacres and outrages which continued until 1856, when they were compelled to submit to American troops and sent to Grande Ronde Reservation, where they remained until the spring of 1857 when they were finally established on Siletz Reservation. Here, with five other tribes, they now number 453.

Rohan, Henri de, ðñ-rē dē rō-āñ, DUKE OF, French general: b. Castle of Blain, Brittany, 21 Aug. 1579; d. Königsfeld 13 April 1638. In his 16th year he joined the court of Henry IV., whose childless marriage led him to entertain the hope that, as a very near relative, he might one day succeed him in Navarre, but in 1610 the assassination of the king dashed all his hopes. The opposing parties again flew to arms and Rohan placed himself at the head of the Calvinists. But Louis XIII. and Richelieu, the all-powerful minister, annihilated the political existence of the Huguenots. Rohan then withdrew from his native land, and in exile wrote 'Mémoires sur les Choses advenues en France depuis la Mort de Henri IV.' (1630). In the wars of Venice against Austria he commanded the troops of the republic till the Peace of Cherasco in 1631. Later he went to Geneva, where he composed his 'Mémoires et Lettres sur la Guerre de la Valteline' (1638). In Germany the Roman Catholic league had made war against the Protestants, and Rohan in 1638 joined Bernard of Weimar, then commanding the Protestant army on the Rhine. He was wounded at the battle of Rheinfelden, 28 Feb. 1638, and his death followed shortly afterward. Besides the works mentioned above he wrote 'De l'Intérêt des Princes et Etats de la Chrétienté' (1638).

Rohan, Louis René Edouard, PRINCE DE. See DIAMOND NECKLACE.

Rohilkhand, rō-hīl-kūnd' or -kānd', or **Rohilcund**, India, a division of the United Provinces of Agra and Oudh, bounded north by the Himalayas, separating it from Kumaon, west and southwest by the Ganges, and east and southeast by Oudh; area, 10,885 square miles. The surface is a plain, with a gradual slope south, in which direction its principal streams, Ramganga, Deoha, and others, flow. Its north frontier is occupied by an extensive forest; elsewhere palms, the sugarcane, cotton, and the finer fruits of the temperate zone flourish. It

takes its name from the Rohillas, an Afghan tribe, who gained possession early in the 18th century. The division is subdivided into the districts Bijnur, Muradabad, Budaon, Bareilly, Terai, and Shahjahanpur. It encloses the native principality of Rampur. Pop. of division, 5,343,674.

Rohlfs, rōlfs, Anna Katharine Green, American novelist: b. Brooklyn, N. Y., 11 Nov. 1846. She was graduated from Ripley College (Poultney, Vt.), in 1867, and in 1884 was married to Charles Rohlfs. In 1878 she won a great success with 'The Leavenworth Case,' a detective story with an ingenious and well-elaborated plot. With the exception of a dramatic poem, 'The Defence of the Bride' (1882), and a drama, 'Rifisi's Daughter' (1887), her other works follow similar lines. Among the titles are: 'A Strange Disappearance' (1879); 'The Mill Mystery' (1886); '7 to 12' (1887); 'A Matter of Millions' (1890); 'Marked Personal' (1893); 'Dr. Izard' (1895); 'That Affair Next Door' (1897); 'The Circular Study'; 'The Filigree Ball' (1903); 'The Millionaire Baby,' and 'The House in the Mist' (1904).

Rohlfs, Friedrich Gerhard, German African traveler: b. Vegesack, Germany, 14 April 1831; d. Godesburg, Prussia, 3 June 1896. He was educated at Heidelberg and Göttingen and in 1855-60 served as a surgeon in the French army at Algiers. He traveled through Morocco in 1860 and in 1862 explored the Tafilet Oasis. He traveled in North Africa in 1863 and in 1865, joined the English expedition to Abyssinia in 1867, and in 1868 traveled in Cyrenaica. He conducted an expedition through the Libyan Desert in 1873-4, traveled in North America in 1875-6, and in 1878 again visited Africa, penetrating to the Kufra Oasis. He traveled in Abyssinia in 1880 and in 1884-5 acted as German consul at Zanzibar. He wrote: 'Journey through Morocco' (1869); 'Across Africa' (1874-5); 'My Mission to Abyssinia' (1883); 'What News from Africa' (1887); etc.

Rojas y Zorrilla, rō'hās ē thōr-rēl'yā, **Francisco de**, Spanish dramatist: b. Toledo, Spain, 4 Oct. 1607; d. about 1680. Information concerning his life is of a fragmentary character and he is frequently confused with several other persons of the same name. He seems to have studied at the universities of Toledo and Salamanca and his work had become famous by 1632, as Montalván mentions him in high terms in his 'Para Todos' of that year. There was a rumor that he had been assassinated in 1638 but it was clearly unfounded, as in 1644 he was honored with the mantle of the Order of Santiago, an evidence of favor at court. He was author of numerous plays and sacred pieces, but took no pains to preserve his works and many of them have been lost, though he did publish two 'Parts' of his dramas (1640-5) and announced a third which never appeared. Among the best of his remaining works are: 'Del Reyabajo ninguno'; 'Entre bobos anda el juego'; 'Lo que son mujeres'; 'Casarse por vengarse.' No complete edition of his remaining works has been published, but an excellent selection is given in Rivadeneyra's 'Biblioteca de Autores Españoles' (Vol. LIV., 1866).

Rokitansky, rō-kē-tān'skē, **Karl**, BARON VON, Bohemian anatomist: b. Königgrätz 19 Feb. 1804; d. Vienna 23 July 1878. He studied at Prague and Vienna; became professor of pathological anatomy at the University of Vienna in 1834, and continued there until 1875. His great work, 'Handbuch der pathologischen Anatomie' (1842-6), stands as the foundation of the science of pathological anatomy. It was translated by order of the Sydenham Society in 1849-52. In 1869 Rokitansky became president of the Austrian Academy of Sciences.

Roland, Jean Marie de la Platière, zhōn mā-rē dē lā plā-tē-ār rō-lān, French patriot: b. Thizy (Beaujolais) 18 Feb. 1734; d. Rouen 15 Nov. 1793. From a humble position in the mercantile world, he rose to eminence in the city of Amiens, in which he held the office of inspector of manufactures. His interests, however, were not in trade, and his views upon political economy and the great problems of government brought him into the ranks of the philosophers of his day. In 1780 he married Manon Jeanne Philpon, whose share in the Revolution was even greater than his own. At the outbreak of the Revolution he joined the Moderate Republican party, during whose brief rule he was made minister of the interior. This position he held from March until June 1792, when the Girondists were forced to retire. After the conflict in Paris 10 August, Roland was recalled, but the Jacobin spirit was too strong, and he was forced to flee. Upon hearing of the death of his wife he took his own life. Consult Lamartine, 'Histoire des Girondins' (1847: English translation by Ryde).

Roland, Manon Jeanne Philpon, wife of Jean Marie Roland (q.v.): b. Paris 17 March 1754; d. there 9 Nov. 1793. With a mind bent upon interests far beyond her years from earliest childhood. Mademoiselle Philpon, the daughter of a Paris engraver, developed at 19 remarkable talents, and at 24 into a woman of great brilliancy of intellect, a disciple of Rousseau, the emancipation of the common people her creed, and their deliverers, the philosophers and patriots of France, her friends and counsellors. In 1779 she was married to M. Roland, with whose political fortunes her life was thenceforth bound. Her faith in the outcome of the Revolution was that of a devotee, her enthusiasm the inspiration of a great party. At first the friends and confidants of Robespierre and those who were afterward leaders of the Jacobin element, the Rolands became the defenders of the more moderate republican idea, and were among the greatest martyrs to this cause. On the fall of the Girondists in the summer of 1793, Madame Roland was arrested, and on the 9th of November was guillotined. During her imprisonment she wrote her famous 'Mémoires,' which were afterward published, together with her correspondence with the other leaders of the French Revolution. Consult: Lamartine, 'Histoire des Girondins,' English translation by Ryde (1849); 'Correspondence de Madame Roland,' edited by C. Perroud (1901); Tarbell, 'Life of Madame Roland' (1896).

Roland, rō'land (Italian, ORLANDO), hero of romance and one of the paladins of Charle-

magne, of whom he is represented as the nephew. His character is that of a brave, unsuspicious, and loyal warrior, but somewhat simple in his disposition. According to the 'Song of Roland' (11th century) which forms part of the 'Chansons de Geste,' Charlemagne, after a six years' stay in Spain, resolved to return home. By the advice of Roland the emperor sent Ganelon to Saragossa to receive the homage of the Saracen king Marsilius. This mission had been fatal to all who had been formerly sent on it, and Ganelon, to revenge himself on Roland, betrayed to Marsilius the line of march of the Christian army. Marsilius collects an immense host, allows Charlemagne to cross the Pyrenees with the main body of his force, and falls upon the rear-guard commanded by Roland (778). A desperate struggle ensued; 100,000 infidels fell, and Roland had only 50 remaining of the 20,000 warriors whom he had led into the narrow pass of Roncesvalles (Roncevaux). Another pagan army hastens up. Seeing himself now fairly overpowered Roland at last sounds his enchanted horn, which is heard beyond the mountains by the emperor. The traitor Ganelon, however, deceives Charlemagne with the assurance that Roland is only engaged on a deer hunt. Thrice the sound of the ivory horn is heard and unanswered, but another blast, the violence of which cracked Roland's temples, alarmed the emperor for the safety of his favorite warrior. He hurries up to his assistance, but it is too late; Roland, wounded in many places, has dragged himself to die at the foot of a tree, has sung his death song and thrown down his enchanted sword, Durandal, and the ivory horn, and covered them with his body. Nothing remains but to avenge the death of the hero, and this Charlemagne does in a series of bloody victories, with the narration of which the poem closes. The poems of Pulci, 'Morgante Maggiore'; of Boiardo, 'Orlando Innamorato'; and Ariosto, 'Orlando Furioso,' relate to Roland and his exploits. Consult: Einhard, 'Vita Caroli Magni'; Turpin, 'De Vita Caroli Magni et Rolandi'; Schmidt, 'Ueber die italienischen Heldengeschichten aus dem Sagenkreis Karls des Grossen' (1820).

Rolfe, rōlf, **William James**, American Shakespearian scholar: b. Newburyport, Mass., 10 Dec. 1827. He was educated at Amherst College, and after teaching in Wrentham, Mass., became master of the high school, Dorchester, Mass., in 1852. In 1857 he was master of the high school at Lawrence, Mass., in 1861 of the high school at Salem, Mass., and from 1866 to 1868 of the high school at Cambridge, Mass., resigning in the year last named to devote himself to literary pursuits. His Shakespearian labors began in 1867 with his editorship (with J. H. Hanson) of Craik's 'English of Shakespeare.' In 1870 he issued an annotated edition of 'The Merchant of Venice' and followed this with other annotated plays till in 1883 a complete edition of Shakespeare had appeared in 40 volumes. This is sometimes styled 'The Friendly Edition,' a name first suggested by Mary Cowden-Clarke (q.v.). He has also edited 'Select Poems of Goldsmith' (1875); Gray (1876); Browning (1887); and Wordsworth (1889); a complete edition of Scott

ROLL — ROLLIN

(1887); and of Tennyson (1895-8), and other works, and is the author of 'Satchel Guide to Europe,' revised yearly (1872-1903); 'Shakespeare the Boy' (1896); 'Life of Shakespeare' (1902). He has lectured much upon Shakespeare and literature in general and in his editions of Shakespeare and other poets has admirably preserved the balance between textual and literary criticism.

Roll, rôl, Alfred Philippe, French painter: b. Paris 10 March 1847. From being a designer of patterns and decorations of various sorts he passed to the Ecole des Beaux Arts at Paris, where he was much attracted to the work of Jerome and Bonnat. The influence of both these teachers is traceable in his pictures, especially that of Bonnat in the duskiness of coloring which prevails in his 'Scenes from the Flood at Toulouse in June 1877,' a picture which gained a medal of the first class, and is now in the Havre Museum. In succeeding pictures he developed a passion for naturalism of the most uncompromising character, and in his 'Feast of Silenus' (1878) (in the Museum of Ghent), and still more in the 'Strike of the Colliers' (1880), now in the gallery of Valenciennes, and 'Labor' (a representation of masons, bricklayers, and carpenters at work on a building), this tendency is conspicuous. These are all blazing sunlight pictures, as if executed *en plein air*, and in like style are his subsequent works whether portraits, genre-groups, landscapes, or marines. They are solidly painted with a matter-of-fact air of reality which is very striking. Among his later works is a canvas crowded with figures, 'The Centennial Jubilee of the Revolution of 1789' (1893).

Rolla, Alessandro, Italian violinist and composer: b. Pavia 22 April 1757; d. Milan 15 Sept. 1841. He was active for many years as musical director at La Scala theatre and teacher in the Conservatory in Milan, and published several quartet and solo pieces as well for the violin as for the bass viol, which for essential purity of composition and perfection of form stand preeminently superior to similar works of his day.

Rolla, rôl'a, Mo., city, county-seat of Phelps County; on the Saint Louis and S. F. railroad; about 48 miles south-southeast of Jefferson City, and 110 miles southwest of Saint Louis. It is in an agricultural and iron mining region. Its chief industrial establishments are smelting furnaces, foundries, machine shops, flour and grist mills. It is the seat of the Missouri School of Mines and Metallurgy, a department of the Missouri State University (q.v.), organized in 1871. Pop. (1890) 1,592; (1900) 1,600; (1910) 1,791.

Roller, a tropical bird of the genus *Coracias*, forming the type of the family *Coraciidae*. These birds are generally of small size, and frequently exhibit brilliant colors in their plumage, and are confined in their distribution to the eastern hemisphere. The food consists partly of insects and partly of nuts and fruits. The common roller (*Coracias garrula*) is found in Africa, whence it migrates in summer northward into Europe. In size the roller equals the common jay. The back is of a light brown color. The head is bluish-green, as also are the neck and lower surfaces. The lesser coverts of the

wings are bright blue; the tail-feathers blue, with a greenish lustre. The voice is noisy and harsh. In habits these birds are shy, and frequent forest depths and secluded spots. The four pure white eggs are frequently deposited in the holes of trees or in holes in river banks. The genus *Eurystomus* is nearly similar to *Coracias*, but occupies tropical Africa. Both genera include several distinct species. Consult Evans, 'Birds' (1900).

Roller Skate, a skate patented in France as early as 1819. Since that time scarcely a year has passed without the recording of some improvement in wheel skates. Plimpton's improvement consisted in so gearing two pairs of wheels that they would "cramp" when the foot-plate was canted to either side, and thus cause the skate to move on a curved line. Several years elapsed before the value of the invention was generally recognized; but in the meantime the inventor was busy making improvements and taking out other patents and in 1874 had brought the skate practically to its present condition. This device of "cramping" the wheels secured the initial success of roller skating. The earlier inventions were crude affairs compared with the modern appliances; the present roller skate combines strength, lightness, and ease of action in a marked degree. About 1864 the mania for roller skating appeared in England; but in 1866 the "rinking" fever broke out in Australia, and spread thence to England and the United States. Since that time the craze has appeared at intervals only to again die out. The most recent of these arose in 1884-5 in the United States, but soon shared the fate of its predecessors. The most recent form has only two wheels, set one behind the other, and resembling the ice skate in its form and action.

Rollin, rô-lân, Ambrose Lucien, West Indian historian: b. Trois Rivières, Guadeloupe, 1692; d. Point à Pitre, Guadeloupe, 1749. He was appointed deputy-lieutenant of the colony in 1725, an office which he occupied until his death, and devoted himself in his leisure to researches upon the Caribes and other Indian tribes. His works show remarkable care and ability and are still accepted as authoritative. They include: 'Histoire des Indiens' (1739); 'Histoire et Description des Caraïbes, leur Condition avant la Conquête' (1734); 'Les Incas du Pérou et la Conquête Espagnole' (1748); etc.

Rollin, Charles, French historian: b. Paris 30 Jan. 1661; d. there 14 Sept. 1741. He studied theology at the Sorbonne, but did not take orders. In 1688 he obtained the chair of eloquence in the Collège de France, of which he became rector in 1694, and he there revived the study of Greek language. In 1696 he was chosen coadjutor or head of the College of Beauvais. Displaced in consequence of his connection with the Jansenists, he was reinstated in 1720. His productions are 'Traité des Etudes' (1726-31); 'Histoire Ancienne' (1730 and 1738), his best known work; and 'Histoire Romaine' (1738-48) to the war against the Cimbri (completed by Crevier and others). Rollin's writings are distinguished for purity and elegance of style, but are diffuse and prolix, and his historical works are deficient in critical sagacity. There is an edition of his works in 30 vols. (1827), with notes on the historical parts by Guizot. His 'Ancient His-

tory' has been often reprinted in English, but is now quite out of date.

Rollin, Ledru. See LEDRU-ROLLIN.

Rolling Mills are machines employed to convert masses of metal into bars or plates, and consist of a series of rollers in pairs, variously arranged, between which the metal is passed and receives successive reductions in thickness and a consequent increase in length or breadth, as the case may be. The rollers are made of steel, and are mounted on massive frames capable of withstanding enormous strains. They have plain or grooved surfaces according to the purposes for which they are employed, and are driven by powerful horizontal reversing steam-engines, by cog-wheel connections and axle gearing. Of the many purposes for which they are employed, perhaps the most important is the manufacture of rails, bridge work and other structural shapes, pipes or tubes, wire, and plates of various kinds such as armor plate, boiler plate, etc. (See PIPE, MANUFACTURE OF.) In the manufacture of rails, the ingot of cast metal is placed in the soaking pit and heated to a white heat. It is then taken to the blooming mill and passed through the blooming rolls seven times and reduced to a bar of a section 9 inches square, and 15 feet long which is subsequently sheared into two or three pieces, according to the length of the desired rail. These pieces called "blooms" are then heated in the bloom furnaces from which they are taken to the rail mill, which consists of a series of grooved rollers arranged in three sets—the roughing rolls, the intermediate rolls, and the finishing rolls. These rolls are placed one beyond the other and extend over an interval of about 900 feet. The hot blooms are passed through them successively. Through the roughing mill the bloom is passed five times and reduced approximately to the section of the desired rail. It is then passed through the intermediate rolls five times and brought still closer to the desired section. It is now placed upon a cooling table for a period of time ranging from 45 to 90 seconds, depending upon the weight per pound of the rail, and then passed through the finishing rolls and brought to the exact section required. After leaving the finishing rolls the rails are cut up into lengths of 30 or 60 feet, as required, then passed through the cambering rolls where they receive sufficient camber to insure of their remaining true and straight when cooled. Rail rolling mills have a capacity of turning out from 7,000 to 8,000 rails per day, requiring about 3,000 tons of metal. (See RAILS, MANUFACTURE OF.) In the manufacture of bridge and other structural shapes, a brief description of the rolling mills of the Pencoyd Iron Works, Pencoyd, Pa., will serve to indicate their enormous capacity. The output of their open-hearth department amounts to 46,000 tons of ingots per week. This mass of metal is converted into finished shapes by a plant of five mills—a 23-inch, three-high roll train, for rolling shapes; a 12-inch, three-high roll train, for rolling angle and T irons; a 28-inch, two-high reversing roughing mill; a 36-inch, two-high preparing mill; and a 23-inch, three-high finishing mill; each of which is driven by 30 x 36-inch double reversing engines geared directly to the mills. For use of rolling mills in wire-making, see WIRE, MANUFACTURE OF.

Rollins, röl'inz, Frank West, American politician: b. Concord, N. H., 24 Feb. 1860. He was graduated from the Massachusetts Institute of Technology in 1881 and later attended the Harvard Law School. After a brief practice of the law, he became a banker in Boston. In 1884 he was elected to the New Hampshire Senate, and in 1898 was elected governor of that State. In this capacity he served two years. The idea of "Old Home Week," established in New Hampshire during his administration, and adopted by many of the older States, originated with Governor Rollins. He has published 'The Ring in the Cliff' (1877); 'Break o' Day Tales' (1895); 'The Lady of the Violets' (1898); 'Old Home Week Speeches' (1900); etc.

Rollins College, located at Winter Park, Fla.; established in 1885. It is not under direct denominational control, but is closely affiliated with the Congregationalists. It has a collegiate and preparatory department, the former conferring the degree of bachelor of arts. It is co-educational, and the number of women in attendance usually nearly equals the number of men. The grounds and buildings in 1910 were valued at about \$90,000; the library contained 8,000 volumes; the annual income was over \$60,000. The students numbered 200 in both departments, and the faculty 20.

Rollo, röl'ō, Norwegian conqueror of Normandy: d. 930. According to tradition he was named "Walking Rolf" (Ganger Rolf), because no steed could carry him. He fought for several years in France, and finally made peace in 912, receiving from Charles the Simple for himself and his freebooting followers a tract along the Seine between the Eure and Epte. He became a Christian, was baptized at Rouen, and took the title Duke Robert. See NORMANS.

Romagnosi, rō-mān-yō'sē, Giovanni Domenico, Italian jurist and philosophe: b. Salso Maggiore, Italy, 13 Dec. 1761; d. Corfu 8 June 1835. He was educated at Pavia and established himself as an advocate at Trent. He was appointed professor of law at Parma in 1803 and in 1806 went to Milan to assist in preparing a code of penal procedure which was later adopted. A chair of law was established expressly for him at Milan, but after the downfall of Napoleon he lost his position. He continued to lecture until 1817 and in 1818 was tried for treason but acquitted. He subsequently supported himself by giving private lessons and continued in abject poverty until his death. Among his works are: 'La genesi del diritto penale' (1791); 'Introduzione allo studio del diritto pubblico universale' (2 vols. 1805); etc. Complete editions of his works were published in 19 volumes (1832-5) and in 15 volumes (1836-45).

Roma'ic. See GREECE, *Modern Greek Language and Literature.*

Romaika (rō-mā'ī-kā) Dance. See PYRRHIC DANCE.

Romaine, rō-mān', William, English Anglican divine: b. Hartlepool, England, 25 Sept. 1714; d. London 26 July 1795. He was educated at Oxford, held several small curacies prior to 1748 when he went to London to hold a lectureship at the united parishes of St. George's, Botolph Lane and St. Botolph's, Billingsgate. In

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1749 he became attached to St. Dunstan's-in-the West and the next year became morning preacher at St. George's, Hanover Square. He was a follower of Whitefield, an ardent evangelical, and suffered much persecution in and out of the church for his views, and on account of the congregations of the poor that he assembled. As a consequence he lost his appointments and held others but for a brief period until 1764, when he was inducted to St. Ann's Blackfriars, and was elected by the parishioners to St. Andrew of the Wardrobe. This election, though disputed, was confirmed by the court of chancery and he held the pulpit until his death. He published: 'The Life of Faith' (1763); 'The Walk of Faith' (1771); 'The Triumph of Faith' (1794).

Roman and Greek Gods. The following are among the more prominent gods in Roman and Greek mythology:

Gods	Greek	Roman
King of Gods.....	Zeus.	Jupiter.
God of Water.....	Poseidon.	Neptune.
God of the Lower Regions.	Pluto.	Pluto.
Messenger of the Gods....	Hermes.	Mercury.
God of War.....	Ares.	Mars.
The Gods' Smith.....	Hephæstos.	Vulcan.
God of Light.....	Apollon.	Apollo.
Goddess of Hunting.....	Artemis.	Diana.
Goddess of Wisdom.....	Athene.	Minerva.
Queen of Heaven.....	Hera.	Juno.
Goddess of Tillage.....	Demeter.	Ceres.
Goddess of the Hearth....	Hestia.	Vesta.
Goddess of Beauty.....	Aphrodite.	Venus.
God of Wine.....	Dionysos.	Bacchus.
God of Love.....	Eros.	Cupid.
God of Time.....	Chronos.	Saturn.
Wife of Chronos.....	Rhea.	Cybele.
Queen of Hades.....	Persephone.	Proserpina.
Goddess of the Rainbows..	Iris.	Iris.
Cup-bearer to the Gods....	Hebe.	Hebe.

See also MYTHOLOGY.

Roman Archæology. See ARCHÆOLOGY.

Roman Architecture. See ROMAN EMPIRE, ARCHITECTURE.

Roman Art. See ART.

Roman Candle. See PROJECTILES.

Roman Catacombs. The "Catacombs of Rome" is the name given to the underground cemeteries, in which were laid to rest the Christians of the Eternal City during the first four centuries. The word itself seems to be a hybrid from the Greek *kata* and the Latin *cum-bere*, and signifies "next the sepulchres." It first came into use at the end of the 3d century as a topographical term for a point of the Appian Way. In the course of time it was applied to the adjoining cemetery of Saint Sebastian, and in the Middle Ages when the other cemeteries were forgotten, it became a general designation for all the early Christian burial-places at Rome. It was a word unknown, however, to the first followers of Christ, who called the sepulchres of the saints, cemeteries, "places of sleep," owing to their faith in the Resurrection. There are some 32 of these larger early Christian cemeteries beyond the Aurelian wall, bordering the ancient Roman roads and encircling the city of the living with a silent city of the dead. The most important are the Catacombs of Priscilla on the Via

Salaria, of Calixtus on the Via Appia, of Domitilla on the Ardeatina, and the Ostrinam on the Via Nomentana. In this Roma Sotteranea there are some 550 miles of underground corridors, honeycombing the soil of the deserted Campagna, and running like streets in all directions and at every angle, now near the surface and again descending to the depth of 75 feet, expanding here into a room and there into a crypt or chapel, along whose sides the faithful were buried in rows one above the other, like the shelves of a shop, or the bunks of a vessel. The corridors average about three feet in width and six feet in height, and were dug generally in three or four levels, ranging from 30 to 50 feet below the surface of the soil. The niches, called *loci*, or *loculi*, which contained the bodies, were closed by a marble slab or a series of tiles, on which was frequently carved some inscription. To understand the origin of the Catacombs, it is necessary to keep before our minds, (1) the funeral customs and laws of Imperial Rome; (2) the early Christian mode of burial; and (3) the nature of the soil out of which sprung the famous seven hills. (1) The ancient Romans had a great reverence for their dead. *Religiosum locum unus quisque sua voluntate facit, dum mortuum infert in loco suo.* Wherever a body rested became *terra sancta*, sacred soil, subject to the authority of the pagan pontiffs. Hence burials were forbidden inside the walls, and the ways leading out of the city were lined from the first to the third milestone with the mausolea, whose richness was one of the glories of the Imperial City, as their ruins are one of the beauties of modern Rome. The pagan mausoleum consisted of three parts, the monument proper, the area or lot of ground, and the underground vault in which the ashes were placed in dovecot niches, known as *columbaria*. These burial plots with their magnificent monuments were owned by burial societies as well as by families, and were fully protected by the law. The Christians likewise, either singly or collectively, erected their mausolea along the highways beyond the walls, and this property, even in times of persecution, was safeguarded by the majesty of Roman law. Hence it often happened that while the law spilled the blood, it spared the body of the Christian. The opinion sometime current that the bodies of the martyrs were buried by stealth, and that the pagan authorities were ignorant of the existence and extent of the Catacombs, is altogether unfounded. The Catacombs were registered under and recognized by the law. They enjoyed the privilege of sacrosanct soil. Indeed many of the bodies were interred in surface cemeteries as to-day. (2) The first faithful originated no special mode of burial. They generally followed the customs of the people among whom they lived. They adopted the Jewish practice of interring, instead of the Roman method of cremating, on account of their belief in the resurrection of the flesh. The sepulchre hewn in the rock, where the body of Christ was laid, was the resting place too of the Christian body. This was first wrapped in a tunic or winding sheet previously coated with a preparation of plaster, was covered with perfumes and flowers, and placed in one of

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the niches cut out of the subterranean crypt or along the corridor. In the case of the martyrs or wealthier converts the bodies were laid sometimes in a marble sarcophagus or in an arched grave hewn out of the rock, termed *arcosolium*, and called *bisomus* or *trisomus*; according to number of bodies it contained.

(3) The soil of the Roman Campagna is of volcanic origin, and consists of three distinct sorts of tufa; (1) the lithoid tufa or peperino, a hard building stone; (2) the fine pozzalana sand used in making the Roman cement; (3) a granular tufa, of no commercial value. However this granular tufa was readily worked, and it is precisely in this strata that we find the Catacombs. The workmen followed these veins in excavating, thence the apparent confusion of the courses and distance of the depths. It was thought at one time that the Catacombs, like the *arenaria*, were excavated for building purposes, but modern research has shown that they are of distinctively Christian origin, and have nothing in common with the *arenaria* either in mode or material of construction.

Origin.—The genesis of the grave among the faithful at Rome was something like this. The wealthier Christians owned their burial lots along the public roads leading out of the city. They had their monument fronting the way, marked with the name of the family. Thus for instance was the case with "*Sepulchrum Flaviorum*" on the Ardeatine Way. The crypt beneath instead of being fashioned into a columbarium, had the graves cut out of the soil. At first this crypt was placed at the disposal of the brethren of the *Ecclesia Fratrum*, and as the number of burials increased, the crypt was gradually extended under the entire surface of the lot. Thus the Catacombs in the first and second centuries were little more than the private burial vaults of the wealthier Christian converts. These original centres of excavation have been recognized in many cases, as for instance, the crypt of Lucina in Calixtus, the Greek Chapel in Priscilla, and the *Spelunca magna* in Prætextatus. At the beginning of the 3d century, the cemeteries passed from private to Pontifical control. About the year 197, Zephyrinus appointed the deacon Calixtus to take them in charge, and the latter has bequeathed his name to the best known of them, which became the official burying place of the Bishops of Rome in the 3d century, and contains the famous papal crypt. Henceforth the Catacombs were owned and administered by the Church. Each one of the 25 parishes in which Ecclesiastical Rome was divided in the 3d and 4th centuries had, roughly speaking, its corresponding cemetery. The identification of the tituli and the cemeteries has been established in a number of instances. With the increasing number of the faithful were formed burial societies among the brethren, which, like the pagan societies, provided by the payment of dues for the benefits of burial to deceased members. They owned their own lots, had their own houses built above the ground, in which they met to celebrate their agape and funeral feasts. Hence there was nothing incongruous in the Christians assembling at the Catacombs on stated occasions to

keep the anniversary feasts of their martyrs. Similar celebrations were held by the pagans themselves, and there is a striking resemblance between the liturgy of these pagan funeral feasts and the language of the Roman martyrology. The inviolability of the cemeteries was undisturbed even in times of persecution, save by Valerian, in 258, and Diocletian, in 303. The part played by these burial societies in the Church is still in dispute. De Rossi has advanced the theory that the Church in the 3d century owned its property as a burial society, as *Ecclesia Fratrum* or *Ecclesia Cultorum Verbi*. Duchesne, however, contends that even in period of persecution, the Church was recognized as a religious society, capable of holding property. The work of excavating was under the care of a distinct class, called *fossores* or diggers. They were regarded as an inferior sort of clergy, and many of the rude inscriptions were made by them.

The Constantine Period.—It has often been said that the victory of Constantine brought the Church from the Catacombs to the Cathedral. The reverse is literally true. It was precisely in the era of peace, that the Church betook itself to the Catacombs, and that they attained their largest growth and grandeur. Everyone wished to be buried close to the martyrs of Christ. *Quod multi cupiunt et rari accipiunt*, we read in an inscription of the year 381, of one who had obtained burial near the sepulchre of the saints. The crypts of the martyrs were changed into triumphal halls of fame. They were decorated with the choicest of marbles from the wealth of the Imperial City. New corridors and entrances were cut, the old ones were joined together. Metrical hymns of praise were placed above the graves of the chief martyrs, especially by Pope Damasus. Lights were kept burning before their shrines, and thither the devout of the city were continually flocking to implore the intercession of the saints or to honor their memory. Even the great Constantine basilicas of Saint Peter on the Vatican, Saint Lawrence on the Labicana, Saint Paul on the Ostian, Saint Agnes on the Nomentana, were but triumphal canopies erected over the tombs of these Christian heroes. Toward the end of the 4th century the custom of burying in the surface cemeteries began to prevail, and after the sack of Rome by Alaric, in 410, interment in the Catacombs ceased altogether.

Period of Decline.—In the succeeding centuries they were chiefly centres of devotion and terms of pious pilgrimages from the North. The itineraries of these pilgrimages from England and Germany, some of which have been preserved, were veritable Ariadne-clues in the rediscovery of these buried labyrinths. For some time the Popes of Rome, notably Vigilius (537-555), John III. (561-574), and Honorius I. (625-638), kept the shrines in a state of repair; but after the ravages wrought in the Catacombs by the invading Lombards, Paul I. in 757 and Paschal I. in 817, translated the relics of the martyrs to churches within the walls. Despoiled of the treasures which had attracted visitors, they rapidly fell into decay. With the exception of the Catacomb of Saint Valentinian on the Flaminian, and Saint Sebastian on

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the Appian way, their very existence passed out of the minds of men in the Middle Ages.

Rediscovery and Research.—In 1587 some workmen, excavating on the Via Salaria, chanced upon a Catacomb corridor, rich in paintings and inscriptions. The interest aroused by this discovery has never since died out. Antonio Bosio (1576-1614), the Columbus of the Catacombs, devoted his life to their exploration. His 'Roma Sotteranea' is the first classic on the Catacombs. The researches made by Boldetti and Battari and others in the 18th century were mainly in the interest of controversy. To the Jesuit, Fr. Marchi, belongs the glory of having inaugurated, in 1841, a strictly scientific study of these early monuments and memorials, and the still greater glory of being the Master of Giovanni Battista de Rossi (q.v.), the father and founder of the science of Christian archæology. By his genius and labors he explored and excavated the buried crypts and corridors of the Catacombs, established their identity and called them by name. From broken stone and damaged fresco and forgotten tomb, he gathered together the materials of a monumental Encyclopædia Romana, a storehouse of the treasures of early Christian belief and behavior.

Paintings.—In regard to the many paintings found in the Catacombs, it may be said in general, that the history of the decline of Classic is that of the beginning of Christian art. In fact nearly all the examples extant of Roman paintings in the 2d, 3d, and 4th centuries are in the Catacombs. They show us that the Church baptised the art as well as the language of the Græco-Roman world. While the themes treated for the most part have a direct reference to the grave and beyond, they still illustrate a large part of the creed of the early church. The Catacomb frescoes belong to three distinct periods. In the first and beginning of 2d century, there was properly speaking no Christian art. The methods and motifs of the pagan painter, such as abound at Pompeii, vines, garlands, flowers, fishes, fruits, birds, cupids, etc., appear likewise in the Catacombs. However even among these designs, those that were capable of symbolizing some Christian truth, as the vine, peacock, dove, and fish, predominate. In the 2d and 3d centuries, as the cemeteries pass from private to public control, a series of paintings distinctly Christian begin to appear. They are symbolical in meaning and similar in execution.

In the third epoch which corresponds to the time of peace, the pictures tend to become more and more realistic, until they are petrified in the 5th and following centuries in the rigid forms of Byzantine art.

The Biblical Cycle.—A remarkable parallel between the prayers of the Roman Breviary for the commendation of the soul in the hour of death and the Biblical Cycle of cemeterial paintings, was first pointed out by Le Blant. This correspondence is so exact as to leave little doubt that these paintings derive their inspiration from the funeral liturgies of the Church. The deliverance of Noah in the flood, of Isaac from the sacrificing hand of his father, of Daniel from the lions' den, of the three children from the fiery furnace, of Susannah

from her false accusers, of Jonah from the whale, are the ever repeated themes, and they all correspond to the liturgical prayers for the dying. The raising of Lazarus completes the Biblical Cycle, and this scene is the gospel for the Requiem Mass. Of this series Jonas and Lazarus are most frequently depicted. The designs are evidently symbolic. A man standing in a chest serves to recall Noah and the ark; the story of Jonah is often told in three scenes; the casting from the ship, the vomiting forth from the dragon fish, and the resting under the gourd. But not infrequently the last scene alone is portrayed. In the same spirit the raising of Lazarus is depicted by a man standing upright at the entrance of a tomb.

Pictures of the Saviour.—There is no likeness of Christ attempted in the Catacombs. He is represented by the symbol of the fish and the hidden cross. The fish, in Greek, ἰχθύς formed the famous acrostic Ἰησοῦς Χριστός, Θεοῦ Υἱὸς Σωτήρ (Jesus Christ Son of God Saviour) and whether written or pictured was a mystic symbol of the Saviour. The transpierced dolphin in Calixtus is the earliest copy of the Crucifixion. The disguised cross was also of frequent use, and never has this sign been in higher esteem than the first ages of the Church. It was sometimes represented thus X; again as an anchor J, now as the gamma cross Γ, at other times as a trident Ψ. The Constantine monogram Χ, so called from its use on the Labarum, was the common symbol of the 4th century. It was used even in inscriptions, as *in nomine* Χ or *in pace* Χ. This Χ was the early monogram of Christ, as IHS became the later one, of Jesus. There was no real representation of the Crucifixion till the Middle Ages. The Crucifix is the creation of the ages of faith, and not of the formative period of Christianity. The first pictures in the Catacombs represent Christ as young and beardless, but in the 5th century the Byzantine bearded face with severe features came into vogue. The picture of the Good Shepherd is the Catacomb Christ par excellence. It is found everywhere in the frescoes of the 2d, 3d, and early 4th centuries. The Saviour is represented in the garb of a young Roman shepherd, wearing the short sleeveless tunic, his right shoulder bare, his feet and legs sometimes bare, again covered with shoes and leggings. In some scenes he carries one of the flock upon his shoulders, in others he plays the pipe while they listen, in others still he leads them to pleasant pastures, but always and everywhere it is the Good Shepherd who seeks and saves. This picture of love was the reply of the Roman Church to the harsh doctrine of the Novations in the 3d century.

The Saints.—Most of the pictures of the martyrs belong to the 4th, 5th, 6th, and even 7th centuries when their graves became shrines, and were richly decorated. They are Byzantine in execution and resemble the mosaics of that period. They are valuable as witnessing the style of vestments worn by ecclesiastics of the day. The Virgin Mary appears most frequently in the Catacombs as the central figure in the Adoration of the Magi. These vary in number from two to six, but uniformly wear the Phrygian cap. The two most interesting pic-

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tures of the Madonna are in Priscilla and Ostiano. The former is a 2d century representation of the Virgin with child in her arms, with a prophet in front of them, pointing to a star. It is a picture of much grace and excellent execution. Its classic lines do not appear again in Christian art for more than a thousand years. The latter is a 4th century Madonna and child, where the X is placed on either side, as though it were a painted echo of the Council of Ephesus. The divine maternity of Mary was certainly in the mind of the artist, and the features of this painting are still preserved in Greek and Russian images. The saints are sometimes portrayed as "advocates" introducing into heaven the souls of those whose bodies were buried near their shrines. This ministerial mediatorship of the saints, exhibited in the Catacomb frescoes of the 3d and 4th centuries, became a common theme of the apsidal mosaics of the basilicas.

The Soul.—The soul is frequently represented by a young woman standing with arms outstretched in an attitude of prayer, called an *orans*. In paradise the soul is depicted as a bird flying among the flowers or feasting on the fruits or drinking from the chalice of heavenly delights. The celestial banquet is represented some six or seven times in Saints Pietro and Marcellino by the blessed seated at a semicircular table, feasting upon the mystic fish under the guidance of Peace and Charity. The judgment of soul standing before Christ in the presence of the martyrs, seems to be the subject of some obscure frescoes.

The Sacraments.—In the cemetery of Calixtus are a series of so-called Sacrament chapels, where the decorations are arranged to set forth a number of Christian truths. First, comes the scene of Moses (Peter) striking the rock. "And the rock was Christ." (1 Cor. x. 4.) In the mystic water of grace a small fish is being caught by the Apostolic fisherman. Tertullian has painted the thought in words. "We as little fish are born in the water after our *ixthi*, Jesus Christ." (Tert. de Bapt.) Then succeeds the Sacrament of Baptism, the source of the new life. The catechumen stands in the water, and the priest pours the laver of regeneration on his brow. Next follows the Eucharistic action, portrayed by a priest standing beside a tripod altar containing a fish and some bread, while an *orante* at the other side lifts her hands in prayer. The multiplication of the loaves and fishes and the banquet of Christ with his disciples by the sea of Tiberias next represent the Communion. And finally the resurrection as a result of the Communion is shown in the raising of Lazarus and the deliverance of Jonah. "He that eateth my flesh and drinketh my blood hath life everlasting, and I will raise him up on the last day." (John vi. 55.) There are two representations of the Eucharist worthy of remark. In the crypt of Lucina, the primitive centre of Calixtus, there are two frescoes (about 150 A.D.), in which two large fish carry on their back baskets containing bread and wine. Here Christ, the fish, the *ixthi*, bears the Eucharistic bread and wine which is himself. Saint Jerome would seem almost to speak of this scene: "No one is so rich as he who carries

the body of Christ in a wicker basket and his blood in a cup of glass" (Ep. ch. xxv. ad Rustic). Another painting of first half of 2d century, discovered by Wilpert (1894), in the archaic part of Priscilla, the Capella Græca, seems to be a real representation of the Eucharistic action of the "Breaking of the Bread." Seven persons, one of them a woman, are seated at a semicircular table, on which are two plates with five loaves and two fishes. These, however, are evidently symbolical, for the priest at the head of the table is engaged in the very act of breaking the bread, and before him sits the Eucharistic chalice. This fresco is in a chapel, and seems to be an early representation of the Eucharistic sacrifice. The representations of the other Sacraments are rare and of doubtful interpretation. A general survey of these paintings leads to the conclusion that the early Christians saw nothing in religious representations hostile to the law of Moses; that the early Church had no repugnance to art, and that the art of the Catacombs is Roman and not of Oriental origin. Mgr. Joseph Wilpert has just published an accurate and complete edition of the Pictures of the Roman Catacombs with German and Italian texts (Rome 1903).

Sculpture.—Christian sculpture barely existed before the 4th century. Catacomb conditions were not favorable to its growth. A fresco could easily be painted in the gloom of the grave, but carved marbles were at once expensive and required light and space for execution. Moreover the sarcophagi in the pagan shops were often covered with idolatrous scenes. Some of these have been found in the Catacombs with the pagan images effaced. With the era of peace, however, the faithful began to use sculptured sarcophagi, and a number of them are preserved in the Lateran Museum. As far as workmanship is concerned, they are of inferior merit, being executed at a time when art had greatly degenerated. Some of them are little less than carved creeds, containing on their façade the main mysteries of the Christian religion. They shed much light on the earlier paintings. The clear carving of the 4th and 5th centuries illumines the doubtful fresco of the 2d and 3d. In the sarcophagi, it is Peter striking the rock and Peter to whom Christ gives the law. Hence in the earlier paintings Moses typified Peter. Daniel among the lions on the sarcophagi is evidently Christ on the Cross. Hence we have a key to the early representations of this scene.

Statuary.—But few pieces of statuary have been found in the Catacombs. While idols were on all sides, the faithful seem to have held aloof from this branch of art. However several statues of the Good Shepherd were executed, and one of the 3d century preserved in the Lateran is a most beautiful representation of the subject. The sitting statue of Hippolytus of the first part of the 3d century found in the cemetery of his name, is unique among early monuments. It contains inscribed on the cathedra a list of his works and his computation of the Easter Cycle.

Gold Glasses.—The gold glasses of which many have been found in the Catacombs, consist of a design made of gold leaf, enclosed

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between two pieces of glass, ordinarily at the bottom of the glass. The subjects treated in these glasses of the 3d and 4th centuries, are of two classes. Some of them are genre pictures, ornamented with the portraits of a newly married couple or a family group, and inscribed with such toasts as "Drink! Live!" They were probably gifts for wedding and family feasts. Others used probably in the liturgical functions and perhaps as Eucharistic chalices were ornamented with the ordinary Catacomb cycle of paintings, but especially with the images of the Saints. Peter and Paul, Agnes and the Virgin Mary are the subjects most frequently represented. Eighty out of the three hundred published by Garucci portray Saints Peter and Paul. The constancy of the types, their correspondence with tradition, and the medallion of same characteristics found in Domitilla and attributed to the early part of 2d century, indicate that these are portraits of the Princes of the Apostles.

Mosaics.—There are but few mosaics in the Catacombs, and most of these of the age of peace. The mosaic is the distinctive Christian decoration of the basilica of the 5th and 6th centuries, as the fresco was of the Catacomb in the 3d and 4th.

Lamps.—The common clay lamp is the object most frequently found in the Catacombs. Most of them are in no respect different from those used by the pagans. However in the 3d and particularly in the 4th centuries, they were marked with the Christian emblems of the fish, the Constantine monogram, the Good Shepherd, the palm, etc. They illustrate the way the Christian faith entered into domestic life after the advice of the Apostle: "Whether you eat or drink—do all to the glory of God." (1 Cor. x. 31). The wine flagon and the wine cup, as well as the lamp and the loaf, were stamped with the sign of the cross in the 4th and 5th centuries. The few bronze lamps unearthed are of much more elaborate workmanship and symbolism.

Other Objects.—Rings, seals, and coins adorned with the characteristic symbols of early Christian art, have been found frequently in the excavations, as well as a number of miscellaneous objects, such as children's toys, combs, etc.

Inscriptions.—The numerous Catacomb inscriptions are of the greatest interest to the Christian scholar. The most precious of them have been arranged in the Lateran Museum by De Rossi. The bulk remains yet in the Catacombs and in the gallery of Christian inscriptions at the Vatican. They may be divided according to the method of execution into carved, painted, and "graffiti" inscriptions, the latter being writings rudely scratched on the plaster or tufa; according to time, into the original epitaphs and later laudatory inscriptions; according to language, into Greek and Latin; according to content, into dogmatic and domestic. Many of the tombs are without any inscription whatsoever, and many more are distinguished but by a rude mark or some object pressed into the fresh plaster. As a rule the early epitaphs are the shorter, although brevity is a distinguishing trait of Catacomb epigraphy, in marked contrast to the lengthy pagan eulogies of the time. The name of the

departed, with a short prayer and some symbol as the fish, palm, anchor, or Constantine monogram, to which was sometimes added the date of burial and age, forms the ordinary inscription. "Gerontius, may you live in God," "Lucilla in pace"; are characteristic epitaphs. The word "deposition" is peculiar to Christian epigraphy, implying that the body is consigned but for a time to the soil. The short prayers and symbols on the tombs are in general but a reproduction of the "Memento of the Dead in the Mass," *Ipsis, Domine, locum refrigerii, lucis, et pacis, ut indulgeas, deprecamur*, "Refreshment, light, and peace grant to them, O Lord." This is the requiem chanted and carved in the Catacombs. Despite the fact that the inscriptions are sepulchral, they yet contain much matter of dogmatic and historic interest. They express belief in the unity and trinity of God, in the divinity of Christ, in the Holy Spirit, in the resurrection, and almost every article of the creed is carved on some monument. Especially strong is the testimony of the Catacombs to prayers for and to the dead. Both are sometimes found in one inscription, as this from Domitilla:

VIBAS
IN PACE ET PETE
PRO NOBIS.

"Gentianus,—pray for us because we know that thou art Christ," we read in another. "Holy Martyrs, remember Mary," comes from Aquileia. *Januaria bene refrigera et Roga pro nos*. This last inscription from Calixtus is a fair sample of Catacomb Latinity. It is ornamented with a small box, containing the rolls of the law, the customary representation of the Bible in early Christian art.

Papal Crypt.—The inscriptions of the crypt where the Popes of Rome were interred in the 3d century, are of peculiar interest

ANTEPWS 6 ETI 6 ABIANOS 6 ETI 6 MP

These inscriptions show that Greek was still the official language of the Church in the 3d century. The monogram Mr, martyr, was the official canonization of the Catacombs.

Damasene Inscriptions.—Pope Damasus (304-385), the first Christian archæologist, embellished the tombs of the martyrs with a series of metrical inscriptions, carved on large slabs of marble by his secretary, Furius Dionysius Filocalus. The texts of 40 of these are preserved in the ancient itineraries, and many of the original slabs have been discovered in the excavations of the last 50 years. The inscription of the papal crypt was found broken in 125 small pieces, which when joined together, gave the entire text. Of all these inscriptions, but a fragment of the title at the tomb of Pope Cornelius remains in its primitive position, so thorough was the work of the devastating Lombard and destroying time. The tomb of Damasus himself, so long sought by the archæologists, was discovered at the close of 1903 by Mgr. Wilpert. The work of excavating is still going on, but enough data has already been dug from the depths to make it certain, that whoever would go back to Christ, must pass through the corridors of the Catacombs. Here he will find the mind of the Master in

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the might of the martyr, and the love of the Saviour in the liberty of the slave. Here he will find church and Sacrament, right and ritual, creed and deed. Here he will come upon a society, Catholic in composition and in charity, Christian in faith and in hope, sleeping the sleep of peace and awaiting the resurrection of the flesh in X. The scientific study of the Catacombs has shown that the Christians were numbered in Rome by tens of thousands in the 3d century. "We are of yesterday yet we fill all that belongs to you; we leave to you only your temples." The rhetoric of Tertullian is the reality of the Catacombs. The researches of De Rossi have shown, too, that the acts of the martyrs have much more historical value than the critical school of history was formerly inclined to give them. Further and fuller research will act as *luminaria* to dissipate the darkness which controversy has gathered round the Catacombs. And when the treasures of Roma Sotterranea are all unearthed, should all other witnesses of the faith once delivered to the saints become silent, the very stones of the Catacombs will cry out to the world the wisdom and grace of Christ.

Consult: Lowrie, 'Monuments of the Early Church' (1901), gives in an appendix the best Catacomb bibliography accessible to the English reader.

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Roman Catholic Church. See CATHOLIC CHURCH.

Roman Catholic Church in Canada, The, will be treated in this article under three headings: 1. The Church under the French, from the discovery of Canada until the conquest by England (1534-1763); 2. The Church under the rule of Great Britain, from 1763 until the present day; 3. Present condition.

1. *Before 1763.*—Catholicism was planted in Canada by France, through whose sailors, Aubert de Dieppe (1508), Verazzano (1522), and especially Jacques Cartier (1534), it was discovered about the beginning of the 16th century. Cartier penetrated the estuary of the Saint Lawrence (10 Aug. 1535), and took possession of the country in the name of King Francis I. While endowing his fatherland with new countries, he proposed also to disseminate therein the Catholic faith, as related in the account of his travels inserted in the 'Histoire de la Nouvelle France' by Marc Lescarbot, Paris 1609.

From Cartier to Champlain (1542-1608) a few attempts at colonial settlement in Acadia was succeeded by the foundation of Port Royal (now Annapolis, N. S.). There appeared the first missionaries, Jesuits and secular priests. Champlain visited Canada in 1603, and in 1608 founded the town of Quebec and settled there. In 1615 he invited Recollet Fathers from France, who became the first apostles to the Indians, and inaugurated those missions in the interior of Canada so famous during the 17th century, and in which the Jesuits (1625) and the Sulpicians (1657), soon took such a glorious part.

Two distinct and savage races, the Algonquins and the Huron-Iroquois inhabited the countries just opening up to missionary zeal.

To the Algonquin race belonged the Abenakis the Montagnais, the Attikamèques or Poissons-Blancs, the Otawawas, and several other tribes scattered from Hudson Bay to the western prairies. From the Huron-Iroquois source sprang two great branches: the Yendats or Hurons established between Lakes Huron, Erie, Saint Claire, and Simcoe, and the Iroquois who dwelt south of Lake Ontario, and were divided into five nations: Mohawks, Onondagoes, Senekas, Oneidas, and Caiyoquos. It would appear that the total population of these tribes was not above 100,000 individuals.

The Recollets were the first to devote themselves to evangelization among the Indians. Father d'Olbeau instructed the Montagnais; Father Le Caron penetrated deeply into the land of the Hurons to carry them the true faith, while several fathers remained at Quebec preaching among the colonists and the surrounding savages. During ten years they multiplied their travels, their preachings, opened schools for Indian children, called to their assistance new recruits, and among them Father Viel, who perished in the Ottawa River, victim of the perfidy of a Huron. Consult: F. Sagard, 'Histoire du Canada,' Paris 1686; Ch. Beaubien, 'Histoire du Sault-au-Récollet,' Montreal 1897. Unable to fill the wants of the missions alone, the Recollets called upon the Jesuits (1625), and on their invitation Fathers Brebeuf and Lalemant with other missionaries came to Canada. Their efforts for the conversion of the savages were not attended with the success hoped for, owing to the opposition of the Company of Merchants, to whom the French king had conceded the monopoly of traffic in these regions, on the condition of founding a colony. Louis XIII. and Richelieu replaced them (1627) by the Company of New France who engaged to lead "the people inhabiting Canada to the knowledge of God, and to instruct them in the Catholic, Apostolic and Roman religion." There was no time to see the effects of these good intentions, for less than two years later (1629), Quebec and the colony fell into the power of David Kerth, who fought on the side of England. The missionaries and their helpers were obliged to return to France.

When Canada was returned to France by the Treaty of Saint German-en-Laye (1632), the Jesuits at the request of Cardinal de Richelieu again took up their missions. Father Lejeune organized religious service at Quebec and opened the college of that town (1635), then he plunged into the interior in search of the wandering tribes of Montagnais. Others established a mission at Miscou, and from there branched forth into the peninsula of Gaspé, into Acadia and Cape Breton. Trois Rivières and Tadousac on the banks of the Saint Lawrence became centres of evangelization. Consult 'Les Jésuites et La Nouvelle France au XVIIe siècle,' par le Père de la Rochemontaix, S. J. Paris, 1895.

Meanwhile hospital religious and Ursulines arrived at Quebec (1639), the first to direct a Hôtel-Dieu endowed by the Duchess of Aiguillon, niece of Richelieu; the second at the head of whom was Marie de l'Incarnation, to provide for the education of the girls. These heroic women were rivals in zeal for the conversion of the savages. Consult: Abbé Casgrain, 'Histoire de l'Hôtel-Dieu de Québec,' Québec, 1878;



1. Most Rev. Paul Bruchési, D.D.,
Archbishop of Montreal.

2. Most Rev. Jos Thos. Duhamel, D.D.,
Archbishop of Ottawa.

3. Most Rev. L. N. Bégin, D.D.,
Archbishop of Quebec.

4. Most Rev. Charles Hugh Gauthier, D.D.,
Archbishop of Kingston.

5. Most Rev. Denis O'Connor, D.D.,
Archbishop of Toronto.

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Id., 'Histoire de la Vénérable Marie de l'Incarnation,' Quebec, 1880; 'Lettres de Mère Marie de l'Incarnation,' Paris, 1681.

About this time the Company of Montreal was formed. Its originators were two men of God, M. Olier, founder of the Seminary of Saint Sulpice, and M. de la Dauversière, a pious laic. Its sole aim was the "glory of God and the establishment of religion in New France without charge to the clergy or to the people." Encouraged by Urban VIII., it found in Paul Chomedey de Maisonneuve a faithful executor of its intentions. This illustrious man landed on the island of Montreal which the society had acquired, 18 May 1642, and laid the foundations of Villemarie, now Montreal. With him came Mlle. Mance, foundress of the Hôtel-Dieu, and they were soon joined by Marguerite Bourgeoys, an energetic and saintly woman, who organized the religious of the Congregation of Our Lady (1653) for the education of Canadian girls. In 1657, Mr. Olier when dying, sent to the colony the first four Sulpicians: de Queylus, Souart, Gallinier and d'Allet. Consult: Dollier de Casson, S. S., 'Histoire du Montréal,' published by the Historical Society of Montreal, 1869; Faillon, S. S., 'Histoire de la colonie française en Canada,' Montreal, 1865; Id., 'Vie de la Vénérable Mère Bourgeoys'; 'Vie de Mlle. Mance,' Paris, 1854; Id., 'Vie de M. Olier, founder of the Seminary of Saint Sulpice,' 3 vols. Paris, 1873; P. Rousseau, S. S., 'Vie de Paul Chomedey de Maisonneuve,' Montreal, 1886.

The hour of martyrdom sounded for the Jesuits. After escaping twice from the ferocious Mohawks, Father Jogues died beneath their blows (1646). Two years later (1648), the flourishing mission among the Hurons was completely destroyed by the Iroquois, and five Jesuits, Fathers de Brebeuf, Daniel, Lalemant, Garnier and Chabanel, were overwhelmed in the massacre of their neophytes. Father Buteux also fell a victim to the Iroquois when going to the Attikamègues (1652), and Father Bresnani escaped with difficulty from these barbarians. Consult: Charlevoix, 'Histoire et Description générale de la Nouvelle France,' Paris, 1744; 'Relation des Jésuites,' Quebec, 1858; these two works with the 'Relations inédites de la Nouvelle France' (1672-1779), and other documents have been collected and published with an English translation in the edition of Reuben Thwaites, Cleveland, 1897, under the title: 'Travels and Explorations of the Jesuit missionaries in New France' (1610-1791); Parkman, 'The French pioneers in North America.' These attacks of the Iroquois became the terror of the colony. Montreal owed its salvation only to the bravery of Maisonneuve and to the heroic devotion of young Dollard, who at the head of sixteen companions for several days faced over seven hundred Iroquois, and resisted them to the death.

The year 1659 marks the commencement of the ecclesiastical hierarchy in Canada. Monsignor François de Montmorency-Laval was named Bishop of Petrea and Apostolic Vicar of New France by Alexander VII. The prelate had numerous difficulties with the governors d'Avangour and de Mézy (1663-1665) over the traffic in brandy which was causing ruin among the Indians. He opened a small seminary for

the training of future clerks, and 10 years later (1678), laid the foundations of a large seminary for preparation for the priesthood. In 1674 Quebec was created a bishopric by Clement X.; the jurisdiction of the new see extended over all North America until 1789, the year in which the bishopric of Baltimore was created. To Monsignor Laval are also due, the creation of charges with resident priests, the incorporation of the Seminary of Quebec and its union with the Seminary of Foreign Missions at Paris, the creation of a chapter of canons; in one word a good diocesan organization. He came in conflict with Governor Frontenac and Intendant Talon to maintain the rights of the Church and to extirpate the abuse of the liquor traffic.

Under his episcopacy the missionaries continued their work. The Sulpicians saw two of their number fall beneath the blows of the Iroquois at Villemarie (1663). Shortly after Messieurs Trouvé and de Salignac-Fénelon, brother of the illustrious Archbishop of Cambrai, founded the mission of Kenté (1668), at the point on Lake Ontario where debouches the Saint Lawrence. During fourteen years it was a centre whence the true faith radiated throughout all the surrounding region as far as Niagara. The following year (1669) Messieurs Dollier de Casson and Bréhan de Gallinée, Sulpicians, left Villemarie in the company of Cavalier de La Salle with the resolution of advancing west to the Mississippi. Abandoned by the discoverer they traversed alone the region of the Great Lakes, and returned to Montreal after one year of exploration and research; there M. de Gallinée prepared a relation and made a map of the expedition. We should mention also the Sulpician missions of la Montagne, Gentilly, l'Île-aux-Tourtes, and Lac-des-Deux-Montagnes, all in the environs of Montreal. The Jesuits on their side prosecuted arduously their missions. Father Menard evangelized the Outaouais, Father Allouez penetrated as far as Lake Superior (1665), and Fathers d'Ablon and Marquette planted the cross at Sault Sainte Marie. Other Jesuits joining the explorers Saint-Lusson and de La Salle, took possession of the banks of Lake Huron; and two years after (1670) Father Albanel penetrated, while traveling by the Saguenay, as far as Hudson Bay. The missions to the Iroquois were resumed, but without great success. In 1669 the sedentary mission of the Prairie de la Madeleine was founded to the south of Montreal. There expanded the lily of Canada, that Catherine Tegakouita, who died in her twenty-third year, and for whom the III. Council of Baltimore has asked the process of canonization. This mission transferred to Sault-Saint-Louis, now Caughnawaga, is still flourishing (having over 2,000 members), and after numerous vicissitudes has again come into the hands of the Jesuits. From Canada also went Joliet and Father Marquette on their discovery of the Mississippi (1673). Consult: 'Récit des voyages et découvertes du Père Marquette,' New York, 1855; Reuben Gold Thwaites, 'Father Marquette,' New York, 1902.

Recalled to Canada by Talon, the Recollet Fathers (1670) established themselves at Quebec and had four missions: Trois-Rivières, l'île Percée (Gaspé), Saint-John River and Fort Frontenac on Lake Ontario. In 1682, Mr. Dollier de Casson called them to Montreal, and in

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1692 the missions of Cape Breton and of Plaisance in Newfoundland were confided to them.

Meanwhile Monsignor Laval worn out with his administration, gave in his resignation to Louis XIV. (1684). After four years' sojourn in France, he returned to Quebec (1688), where he lived in profound retirement until his death in 1708. The episcopacy of Monsignor Laval marks one of the most prosperous epochs of the Canadian Church and of the colony. Between 1665 and 1680, thanks to the intelligent activity of Colbert and de Talon, more colonists came to Canada than in the preceding half century. A strict supervision was exercised in the choice of the young women sent, as much as regarded their physical as their moral qualities. Several whose loose manners might have become a cause of corruption and decadence rather than of growth, were rejected. Consult: Gailly de Taurines, 'La nation canadienne,' Paris, 1894; Ferland, 'Cours d'histoire du Canada.'

Monsignor de Saint-Vallier succeeded Monsignor Laval. The new bishop founded the general hospital of Quebec, endowed it with his own contributions, built the episcopal palace, published a catechism for the diocese, established ecclesiastical conferences, and held the first synods. In 1690, the English admiral Phipps, having attacked Quebec with 32 vessels, the prelate in a pastoral letter exhorted the Canadians to bravely do their duty. When after useless efforts the enemy had departed, the bishop dedicated to Our Lady of Victory, the church in the lower town, still standing, as a monument of Heaven's protection.

The era of great missions passed; nevertheless Cadillac and a missionary founded the town and colony of Detroit (1700); the priests of the seminary of Quebec became the apostles of the Tamarois, between the Illinois and the Ohio Rivers; the Jesuits evangelized the Miamis, the Sioux, the Otawawas, the Illinois, and held their ground amid the Iroquois. With the opening of the 18th century, commenced the furious and repeated assaults of England and its American colonies against the little Catholic colony, in which the French Government, careless of the future, became less and less interested. The emigration to New France ceased toward the end of the preceding century. No more were to be seen the great convoys setting sail for America crowded with new populations full of faith and energy. In 1713 the French Canadian population was 18,000, and in 1739 scarcely reached 42,000. It was a small number to resist an adversary which counted in 1706 260,000 individuals, and which was increasing each year.

Acadia especially was weak, having but two thousand inhabitants of French origin. The first attacks were directed against her. After having resisted in 1704 and in 1707, she fell (1710) into the power of the English colonists, and three years later, the Treaty of Utrecht (q.v.) (1713) ceded Acadia, Newfoundland, and Hudson Bay to England. From this epoch to that of the violent dispersal of the Acadians by Lawrence (1755), the Catholics found devoted support in the Sulpicians and the priests of the seminary of Quebec who were their missionaries. The names of Geoffroy, Baudoin, Trouvé, de Breslay, Metivier, de la Gondalie, de Miniac, Chauvreuse, and Desenclaves, of

Saint-Sulpice; of Petit, Thury, Gaulin, of the seminary of Quebec, deserve to be remembered by posterity. Mention should also be made of Father Rasles, S. J., missionary to the Abenakis, who was killed by the English. We will not recall here the incredible atrocities which have relegated Lawrence's memory to the execration of humanity, and which Longfellow has immortalized in his touching poem 'Evangeline.' Consult: Richard, 'Acadia, Missing Links of a Lost Chapter of American History,' (Montreal, 1895); Abbé Casgrain, 'Les Sulpiciens en Acadie' (Quebec 1897); Id., 'Un pèlerinage au pays d'Evangeline' (Quebec, 1885).

These painful events only too plainly foreshadowed the fate awaiting the Canadian colony. Instead of sending men, France persisted in raising at great expense useless fortifications at Louisbourg and at Quebec. Canada was to fall through lack of foresight.

The episcopacy of Monsignor de Saint-Vallier lasted until 1727. The endowments with which he enriched the various religious establishments of the country, have been estimated at \$600,000. His successor, Monsignor Duplessis-Mornay, never came to Canada. He governed his diocese by an administrator. Resigning in 1773, he was replaced by Monsignor Dosquet who devoted himself to promoting the education of youth and the religious life in the communities. Monsignor de Lauberivière who succeeded him, died a month after his arrival in his diocese, victim of his charity in attending soldiers attacked with scurvy (1740). His successor was Monsignor de Pontbriand (1741-1760), the last bishop under the French régime. He built a cathedral, restored the Ursuline monastery at Trois-Rivières and the Hôtel-Dieu of Quebec, which had been destroyed by fire, established ecclesiastical retreats, and by his science and virtue was the model of his clergy.

Among eminent priests of this epoch should be mentioned M. de Belmont, superior of Saint-Sulpice at Montreal (1701-1732), who covered the region with his liberalities and his works; M. Normant du Faradon, his successor (1732-1759), who with the Venerable Mother d'Youville shares the glory of having founded the admirable charitable institution of the Grey Sisters. Consult: Faillon, S. S., 'Vie de la Vénérable Mère d'Youville' (Montreal, 1852). To Saint-Sulpice belonged also that abbé Picquet to whom the town of Ogdensburg erected (1899) a monument, as well as its founder. Consult: 'Lettres édifiantes et curieuses' (Lyon 1819); 'Mémoire sur la vie de M. Picquet' by M. de la Lande, of the Academy of Sciences, p. 262; 'Biographie universelle ancienne et moderne' (Paris 1823, Vol. XXXIV. p. 289); 'Revue canadienne, janvier et février 1870,' Vol. VII.; 'l'abbé Picquet,' by J. Tassé.

The events which precipitated the fall of Canada are well known. Quebec taken (1759), the bishop died at Montreal (1760) without seeing that town in the hands of the English. M. Briand undertook the administration of the region of Quebec; M. de Montgolfier, Sulpician, of that of Montreal. The Treaty of Paris which ceded Canada to England was signed 10 Feb. 1763. The period of establishment closed for the Canadian Church, and that of conflicts and of progress opened.

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2. *After 1763.*—All the natural chiefs of the Canadians recrossed the ocean with the French flag. A population of 70,000 souls was abandoned without a guide. The clergy alone remained, invested with the double mission to preserve the ancestral faith and direct the people in the attainment of their civil and political rights. They understood their mission and it can be truthfully said that they did not fail therein.

The Treaty of Paris, it is true, guaranteed the Canadians "the free exercise of their religion," but with the addition "so much as the laws of Great Britain will permit." This restriction left a great latitude in the interpretation of the treaty. In fact it was a species of persecution. The government of London thought to substitute the Anglican hierarchy and religion for the Catholic hierarchy and religion and flattered itself in easily overcoming the conscience of a handful of colonials. The French laws were abolished and the oath of allegiance exacted from all Canadians. They notified the priests that they would have to subscribe to it or prepare to leave Canada. It was a demand to abjure and rebel against the authority of the Roman See. At the same time they prepared a list of the churches, the priests, their charges, their revenues, their property, also one of the religious communities with their constitutions, rights, privileges, and properties. In addition George III. encouraged the governors to found Protestant schools so that the Church of England could be established in principle and in practice, and the inhabitants gradually be brought to embrace the Protestant religion, and their children educated in the principles of that religion.

The communities of men were also condemned to die out. Recollets, Jesuits, and Sulpicians were prohibited from recruiting in the country or from receiving members from abroad. They took possession of the properties of the first, and as to the Sulpicians, they were reduced from 30 which they were in 1760, to two septuagenarians, whose deaths they awaited to take possession of their effects, when the French Revolution broke out. The English Government then relaxed its rigorous attitude and offered the victims of the furious revolutionists an hospitality which does them honor. The people though were not better treated. For them there were no public positions, no place in the councils of the colony. A species of ostracism followed them everywhere. In the midst of these painful conjunctions the Catholics did not despair; they sent to London petition upon petition claiming on the faith of the treaties the preservation of their religion, their priests, their language, and their civil rights. At last in 1766, George III. consented to the consecration of Monsignor Briand, as Bishop of Quebec, without recognizing any other title, however, than that of Superintendent of the Catholic cult.

Meanwhile a storm was arising in the Anglo-American colonies. The metropolis understood that it should conciliate the Canadians. The Act of Quebec (1774) restored the French civil laws, dispensed with the test-oath, and recognized their civil and political rights. During the war which followed and which terminated with the death of Montgomery (1775)

under the walls of Quebec, the Canadian people, docile to the voice of their clergy, remained faithful to the sovereign which Providence had given them.

During these years the Catholic population had grown: in 1784, it numbered 130,000 French-Canadians; the Maritime Provinces were being peopled by Irish and Scotch Catholics, and the Acadians dispersed in 1755, were grouping silently and multiplying, supported by such apostles as the abbés, Desjardins, Sigogne, de Calonne, and Ciquart, Sulpician. "To these confessors of the faith the Acadian race owed its organization; these were the true founders of its nationality." Consult: 'Vie de l'abbé de Calonne,' (Trois-Rivières, 1892); Casgrain, 'Pèlerinage au pays d'Évangéline.'

After having courageously combated, Monsignor Briand died in 1784. His successor, Monsignor d'Esglis, was an old man of 75 years. He speedily took a coadjutor in the person of Monsignor François Hubert, who became titular bishop in 1788. In a remarkable memoir to the Holy See (1794), the prelate states that his diocese contained 160,000 Catholics; that the efforts of the Anglicans to win the Canadians to their religion were in vain; that his diocese is too vast for him to administer conveniently. But, he added "every plan of division would find insurmountable obstacles on the part of Great Britain which is occupied on the other side in the means to establish in this country a Protestant clergy." Consult: 'Mandements des évêques de Québec,' Vol. XI., p. 474.

Monsignor Denaut (1797-1806), succeeded Monsignor Hubert. Under his episcopacy the fight against Anglicanism is summed up in the Royal Institution. Thus was named a cleverly composed organization designed to monopolize instruction of every degree by concentrating the power in the hands of the governor. The Anglican Bishop Mountain was chosen as president of the Institution. Profiting by a legal restriction the Catholics prevented its success. Consult: S. Pagnuelo, 'Études historiques et légales sur la liberté religieuse en Canada,' (Montreal, 1872).

From 1806 to 1825 the episcopal see of Quebec was occupied by Monsignor Octave Plessis, a prelate distinguished as much by the breadth of his intelligence and the force of his character, as by his courtesy in all proceedings. He had to hold his own against a powerful oligarchy which would not recoil from extreme measures, and which was resolved to make the Church the vassal of the civil power, the slave of the government; in fact to insensibly lead Canada to Anglicanism by the governmental channel. The soul of this plan was a certain Witzius Ryland, secretary of the governors of Canada from 1790 to 1812. It would take too long to enter into the details of this struggle, into which Sir James Craig was weak enough to enter; it suffices to say that Monsignor Plessis by his individuality embodied Canadian resistance without ever wounding English sentiment; that he obtained for himself official recognition of his title, Bishop of Quebec (1813); that he removed the pretensions of the government to nominate rectors; that he ensured the independence of the Church against the State; and that he inspired his adversaries even, with respect and admiration for his great

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character. Faithful besides to the Crown of England, his was the act of a loyal subject in calling to arms his diocesans, on the occasion of the invasion of the United States in 1812. Well and justly could Lord Bathurst reply to the Anglican Bishop of Quebec, J. Mountain, who protested against the favors accorded Monsignor Plessis by the London Government. "It is not when Canadians are fighting for England that such questions should be agitated." Consult: Pagnuelo, 'Etudes sur la liberté religieuse en Canada,' c. IX.-XI., p. 86-120; 'Le Correspondant,' April, 1877; 'La France Canadienne,' by J. Guérard; Garneau, 'Histoire du Canada,' t. III. r. XIII. c. 11. and t. XIV. c. I.; 'Mandements des évêques de Québec,' t. III.; 'Conversation entre Sir J. Craig et Mgr. Plessis,' p. 59; 'Mémoire au gouverneur,' p. 79; French 'Biographical notice of J. O. Plessis, Bishop of Quebec,' (Quebec, 1864); L. O. David, 'Biographies et portraits,' (Montreal, 1876, p. 80); Bédard, 'Histoire de Cinquante ans,' (1791-1841), (Quebec, 1869, c. IV. et V.).

Monsignor Plessis understood the necessity for dividing his vast diocese. Already in 1817 New Scotland was detached with Monsignor E. Burke as Apostolic-Vicar. This did not suffice. Soon the Apostolic-Vicariates were created of Upper Canada with Monsignor MacDonell as titular; of New Brunswick and Prince Edward's Island, with Monsignor MacEachern; of the Northwest with Monsignor Provencher; of the district of Montreal with Monsignor Lartigue, Sulpician (1820). These divisions were completed after the death of Monsignor Plessis, by the creation of the sees of Kingston (1826); Charlottetown (1829); and of Montreal (1836).

In the course of years the number of French-Canadians kept on increasing. In 1831 it attained 380,000. In less than 50 years, it had increased by nearly 280,000 souls. This progress was not of a nature to reassure the intolerant and exclusive set which existed on the side of the Anglo-Protestants. Already, about 1820, they had tried to abolish the constitution of 1791, which assured an independent existence to the Province of Quebec, and wished to unite Upper and Lower Canada, with the scarcely veiled object of outnumbering the French Catholic population. This plan had failed, thanks to the firmness of Bishop Plessis and his clergy, who rallying the forces of the country, victoriously opposed Protestantism. Unfortunately, after the death of the bishop, several influential members of the legislative body deserting the sure ground of legal resistance, slipped upon the slope of revolution, fanned the spirit of revolt by their indignant philippics, and provoked the troubles of 1837-8, when several hundred countrymen led astray by their representatives, flew to arms. Nevertheless, let us say that the voice of the Catholic clergy was sufficiently powerful to keep the mass of the population in the path of duty. The result of this insurrectional movement was the union of the two Canadas. The Act of Union was passed by the Britannic Parliament 23 July 1840.

Before this act of despotism (consult Turcotte, 'Le Canada sous l'Union,' p. 60), which marks an important date in the history of Canada, several works had been created, several

deeds accomplished which interest the Church. The seats of education had multiplied: the college of Montreal (1767) founded by M. Curat-teau, priest of Saint-Sulpice, and then (1806-28) so prosperous under the direction of M. Roques; the colleges of Saint-Hyacinthe (1809), of Sainte-Thérèse (1825), of l'Assomption (1832), of Sainte-Anne de la Pocatière (1829). Mention should be made also of the formation of the Société d'éducation of Quebec, to promote primary instruction, and the acceptance of the Factory Law (1824), so favorable towards the same end. To this same period belongs the acknowledgment of the properties of the Seminary of Saint-Sulpice at Montreal by the government of Queen Victoria (1839). This act of justice allowed this venerable institution to follow the course of its charities and to cover the Montreal region with its intelligent liberalities.

To Monsignor Panet, who had replaced Monsignor Plessis (1825-1832), succeeded Monsignor Signay. His episcopacy was marked by many misfortunes: cholera (1834), civil war (1837-8), two fires in Quebec (1845), typhus brought by the Irish driven from their country (1847). The 15 years which followed 1840 were more fruitful for the Canadian Church. Five communities of men, and 15 of women dedicated to the ministry, to teaching, or to charity, came from France to settle in Canada. The Oblate Fathers of the Immaculate Mary (1841), the Jesuits (1842), the clerks of Saint-Viateur, the Congregation of Sainte-Croix (1847), and the Brothers of the Christian Schools answered to the call of Monsignor Ignace Bourget, Bishop of Montreal (1840-79). Then were founded the Sisters of Providence (1843), of the Holy Names of Jesus and Mary (1843), of Mercy (1848), of Saint Anne (1849). At the same time the episcopal sees were multiplied: Toronto with Monsignor de Charbonnel, S. S. (1842); Saint John, N. B. (1842). Quebec elevated to the dignity of an archbishopric received as suffragan sees Montreal, Kingston, and Toronto. The same year (1844) the bishopric of Arichat, N. S., transferred to Antigonish since 1886, was created: in 1847 the see of Bytown or Ottawa and of Saint John, Newfoundland. United in council at Quebec (1851), the bishops decide on the foundation of Laval University and ask the Holy See to establish the sees of Trois Rivières and Saint Hyacinthe (1852). Let us mention also the foundation of societies for colonization, for temperance, of Saint-Vincent de Paul, and of an educational system for separate schools for Catholics.

Meanwhile the Catholic population had increased considerably. In the Province of Quebec it more than doubled in 30 years; in 1831 it counted 425,000, in 1861, 942,800 souls; in Ontario it attained 260,000. This development demanded the multiplication of primary schools. This was the work of J. B. Meilleur, of whom it can be said, "he undertook the direction of Public Instruction from its cradle; that he had to create everything even to the love of instruction among the people." Consult: J. B. Meilleur, 'Mémoire sur l'éducation au Bas-Canada,' Quebec, 1876. The Catholic colleges were opened of Joliette (1846), of Rigaud (1850), of Saint-Lawrence (1847), of Saint Mary of Monnoir and Levis (1853). That

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same year (1853), the Seminary of Quebec undertook the heavy but glorious task to build Laval University which was inaugurated in the presence of Lord Elgin, 14 September 1853, and which since has rendered such immense services to the Catholic cause and to the country. Consult: C. Roy, 'L'Université Laval et les fêtes du Cinquantenaire,' Quebec, 1903.

While these works were being accomplished in the East, the West was opening to evangelization. With Monsignor Provencher, the first apostles of these districts had penetrated along the Red River. Wishing to ensure the future of these missions, the Bishop of Saint-Boniface called to his assistance the Oblate Fathers and even chose from them Father Taché as coadjutor. Monsignor Provencher died in 1853 and was succeeded by Mgr. Taché. He had to expend his intelligence and his strength during 40 years (1853-94). It does not enter into the limited scope of this essay to recount the works of the Oblates in the Far West; although they constitute one of the most remarkable chapters of the Catholic missions. The apostolic-vicariates and the episcopal sees embrace in their jurisdiction every point in these distant regions which came under the indefatigable zeal of these missionaries.

Consult: G. Dugas, 'Monsieur Provencher et les Missions de la Rivière-Rouge,' Montreal 1889; Piolet, S. J., 'Les missions Catholiques françaises,' Paris 1902; Monsignor Taché, 'Vingt années de missions dans le Nord-Ouest de l'Amérique,' Montreal, 1869; Don Benoit, 'Vie de Monsigneur Taché,' Saint Boniface, 1904; Père Jonquet, O. M. I., 'Vie de Monsigneur Grandin,' Montreal, 1904; R. Cooke, O. M. I., 'Sketches of the Life of Monsignor de Mazenod,' London, 1879.

The years which followed 1860 were full of solicitude for the Catholic clergy. The Councils of Quebec show us the bishops preoccupied with the progress of impiety, with evil books, with the weakening of the faith, and painfully affected by the events which led to the invasion of the Pontifical domains by the armies of Victor Emmanuel. The Canadians flew to arms and several detachments of zouaves offered their services to Pope Pius IX. (1868).

The Catholic hierarchy had developed in the course of years. In 1852, Halifax was created an archbishopric with Charlottetown, Saint John, N. B., Arichat, N. S., and soon after Chatham, N. B. (1860), as suffragan sees. The year 1871 marked the creation of the ecclesiastical province of Saint Boniface (Manitoba), with the bishopric of Saint Albert (1871), and the apostolic-vicariates of Athabasca-Mackenzie and of Saskatchewan for suffragans. In the preceding year (1870) Upper Canada was created an ecclesiastical province with Toronto for archbishopric and Kingston and Hamilton for suffragans. Since then Kingston has become an archiepiscopal see (1878) with two suffragans: Peterboro (1882) and Alexandria (1890). In the province of Quebec, Sherbrooke (1874), Chicoutimi (1878), Nicolet (1885) became bishoprics. In 1886, Montreal was created an archbishopric under Monsignor Fabre, with Saint Hyacinthe and Sherbrooke as suffragans, to which have since been added Valleyfield (1893), and Joliette (1904). The same year Leo XIII. created the ecclesiastical province of

Ottawa, which received as suffragan the episcopal see of Pembroke (1898). To crown this flourishing hierarchy, Leo XIII. honored with the cardinal purple Monsignor Taschereau, Archbishop of Quebec (1886). To conclude the study of the second half of the 19th century, mention must be made of three particular points. *a.* The Awakening of the Acadian Race, which had expanded imperceptibly.—From the 25,000 that they were in 1815, the Acadians increased to the number of 80,000 (1864), and 125,000 (1899). To Father Lefebvre, a Canadian priest, is due the merit of having amalgamated them and, in founding the college of Memramcook, N. B., of having contributed powerfully to render them a force for Catholicism in the Maritime Provinces. To-day the Catholics of French origin in that region amount to 155,000. Consult: P. Poirier, 'Le Père Lefebvre et l'Acadie,' Montreal, 1898. *b.* The Schools of New Brunswick and of Manitoba.—In 1867 when the Canadian Confederation was founded, the educational system of New Brunswick allowed the Catholics of that province to have separate schools. This right was refused them in 1871, the aim being to compel them to send their children to the public schools, that is to say, Protestant schools. An organized resistance spread everywhere and to avoid a sanguinary conflict, a compromise was effected. The unjust law was not abrogated but the concessions were of such a nature that peace was re-established (1874).

An injustice of the same kind wronged the Manitoban Catholics in 1890. Despite the vigorous fight led by Monsignor Langevin, successor to Monsignor Taché in the see of Saint Boniface, the iniquity was not amended, but a compromise was arranged between the Laurier Government and the Holy See, which for want of a better, softened without destroying the disastrous effects of the law. This question which so impassioned the minds in 1896 gave rise to the creation of the Apostolic Delegation to Canada, a post first occupied by the present Secretary of State to Pius X., Cardinal Merry del Val, and now, by Monsignor Donato Sbarretti, ex-archbishop of Havana, who succeeded (1902) to Mgr. Diomede Falconio, presently apostolic delegate to the United States. *c.* The foundation of Laval University at Montreal.—For a long time Montreal was in want of a Catholic university. Monsignor Bourget applied to the Propaganda. Not to injure the rights of Quebec, a branch in Montreal was granted by the pontifical bull *Inter varias sollicitudines* (1876). The powers and the autonomy of this branch were signally increased by Leo XIII. (1889). In need of the necessary buildings, the liberality of the Seminary of Saint Sulpice, governed then by M. Colin, filled this void. Laval University at Montreal now has spacious premises and numerous professorships.

3. *Present Condition.*—(a) Ecclesiastical provinces.—The total Catholic population in Canada is estimated at 2,230,008 by the census of 1901. Since then it has increased about 100,000 through immigration. With 1,430,000 Catholics, the province of Quebec alone comprises three-fifths of the faithful followers of Rome in Canada. Nearly 900,000 are scattered throughout the other provinces. Everywhere, except in Ontario, in Manitoba and in British

ROMAN CATHOLIC CHURCH

Columbia, Catholicism exceeds in the number of its adherents any of the separate Protestant sects. It embraces 42 per cent of the total population of the Dominion, which is 5,371,315. From 1890 to 1900 the Catholics increased by over 250,000 souls. This gain was effected despite a very pronounced emigration movement of French Canadians to the Northeast of the United States. The following table gives at a glance the ecclesiastical divisions of the Dominion of Canada:

ARCHBISHOPRICS SUFFRAGAN BISHOPRICS	Titulars in 1904	Catholics	Priests	Churches and Chapels
QUEBEC	L. N. Bégin....	325,000	550	240
Trois-Rivières	F. X. Cloutier....	76,800	110	70
Rimouski	A. Blais.....	99,140	128	116
Chicoutimi	T. Labrecque....	60,000	100	50
Nicolet	H. Brunault....	83,824	118	62
Préf. Apost. du Bas st Laurent	P. Blanche.....	9,650	14	39
MONTREAL	P. Bruchési....	435,000	640	220
Saint Hyacinthe	M. Décelles....	115,000	230	220
Sherbrooke	L. Larocque....	67,000	149	62
Valleyfield	M. Emard.....	65,000	139	39
Joliette	J. A. Archam- beault	65,000	86	42
OTTAWA	J. Duhamel....	140,000	240	123
Pembroke	N. Lorrain.....	50,000	46	46
TORONTO	D. O'Connor....	65,000	103	87
Hamilton	J. Dowling....	50,000	60	55
London	P. McEvay....	60,000	75	77
KINGSTON	G. Gauthier....	45,000	51	69
Peterboro	R. O'Connor....	50,000	59	97
Alexandria	A. Macdonell..	25,000	19	19
HALIFAX	G. O'Brien....	55,000	66	86
Charlottetown	G. McDonald....	52,000	45	45
Saint Jean	T. Casey.....	58,000	63	93
Antigonish	J. Cameron....	75,000	85	85
Chatham	T. Barry.....	60,000	71	71
SAINT BONIFACE... ..	A. Langevin....	65,000	150	151
Saint Albert	E. Légal.....	16,000	53	53
Athabaska (V. Ap.)	E. Grouard....	10,000	10	10
Saskatchewan (V. Ap.)	A. Pascal.....	15,000	24	24
VANCOUVER	B. Orth.....	10,000	25	20
New Westminster	A. Dotenwill..	25,000	45	45
Mackenzie-et-Yukon (V. Ap.)	G. Breynat....	8,000	22	22

On the death of a bishop, the bishops of the province send a list of three names to Rome and the Pope chooses and names a successor. The bishop-designate cannot be consecrated before receiving his bull from the Holy See. He enters immediately on his functions without having to fulfill any civil formality, and the dioceses render their homage and obedience as to his predecessor. The State recognizes in him the rights of a civil corporation. He enjoys besides, the greatest liberty while regarding canonical rules, in nominating vicars, creating parishes, erecting churches and parsonages. Each vicar keeps a registry of births, marriages and deaths. In French-Canada the vicar has the right of tithes for his maintenance. This tithe in spite of its name is but a twenty-sixth part; it is raised on grain alone, and the tendency is more and more to pay it in money. No vicar is irremovable.

(b) Religious Communities.—There are to-day in Canada more than 20 communities of men, eight of Brothers, and 62 of religious. They devote themselves to various forms of charity, of teaching, to parochial ministry or to preaching. They include Sulpicians, Jesuits, the Oblate Fathers of Mary the Immaculate, the clerks of Saint Viator, Dominicans, Franciscans, Redemptorists, the Fathers of the Holy Cross, of the Company of Mary, Eudistes, Basilians, of the Holy Sacrament, and several others. The Brothers of the Christian Schools to the number of 600, have 36 establishments, and instruct 20,000 pupils. The Sisters are to be found in every kind of devoted work: hospitals, asylums, industrial schools, alms-houses, refuges, orphanages, in one word all the miseries that the crowded cities multiply find succor from them. Mention will be made only of the orders founded in Canada:

NAMES	Diocese	Year of foundation	No. of Members	Houses
Congregation of Our Lady	Montreal	1659	1445	121
	Montreal	1747	950	58
	Quebec	1849	800	39
	St. Hyacinthe	1840	160	12
	Ottawa	1845	560	36
Sisters of Providence	Montreal	1843	1660	78
of Jesus and Mary	Montreal	1843	1050	89
of the Holy Cross	Montreal	1847	582	33
of Mercy	Montreal	1848	150	7
of Saint Anne	Montreal	1850	830	54
Servants of the Imm. Heart of Mary	Quebec	1850	340	26
of the Assumption	Nicolet	1853	335	32
Religions of the Holy Family	Sherbrooke	1887	200	20
of the Precious Blood	Saint Hyacinthe	1861	200	70

(c) Universities and Seminaries.—There are three Catholic universities in Canada: Laval in Quebec, Laval in Montreal, and the University of Ottawa, founded by Monsignor Guigues. The first two comprise all faculties except sciences. Medicine, law, and letters have well endowed chairs. Theology has distinctive faculties in the great seminaries of Quebec and of Montreal, the last opened by the Sulpicians in 1840. The University of Ottawa has only the faculties of theology and arts. Secondary education is disseminated by 17 colleges in the province of Quebec, all affiliated to Laval University which alone confers university degrees. Young men destined for the priesthood prepare by two years of philosophy and four of theology. This preparation begins in a great seminary; that of Montreal has nearly 300 aspirants for the priesthood, that of Quebec over 100. There is besides, one at Halifax; and each religious community of men is endowed with an academy where dogmatic and moral theology, the Holy Scriptures, Patrology, Canon Law, Church History and the pastorate are taught. Those young priests who are most distinguished for their intelligence are sent by their bishops to Rome to the Canadian College, founded by the Sulpicians in 1888, where they follow courses given by learned professors of the Roman universities and return with the

degrees of Doctors in Philosophy, in Divinity, or in Canon Law. Consult: Castell Hopkins, 'Canada: an Encyclopedia of the Country,' Vol. V. (Toronto, 1808).

French-Canadian Catholics believe that they have been called by Providence to personate on American soil the rôle that France personated in the Old World. They look upon themselves as destined to fill a mission, and that mission the one that France has filled in Europe; to carry high the banner of the Catholic Church, and among races more inclined to positivism, maintain and propagate the instinct of disinterested devotion, and the worship of the ideal. Consult: Casgrain, 'Histoire de la Vénérable de l'Incarnation,' t. I. p. 95; Gailly de Taurines, 'La nation Canadienne,' ch. XXV., p. 280-291; Massom, 'Le Canada français et la Providence' (Quebec, 1875); P. Ragey, 'Une nouvelle France' (Paris, 1902).

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Roman Catholic Education. See EDUCATION, ROMAN CATHOLIC.

Roman Catholic Emancipation, the abolition of those civil and ecclesiastical restraints to which the Roman Catholics of Great Britain, and particularly of Ireland, were once subjected. By the statutes of William III. Roman Catholics were forbidden to hold property in land, and their spiritual instructors were open to the penalties of felony; and although latterly these restrictions had not been enforced, they remained unrepealed in England until 1778. See EMANCIPATION, CATHOLIC.

Roman Empire, Architecture of the. The ancient buildings of the city of Rome had little influence over the wealthy nobles, the provincial governors, the newly enriched generals of the later republic. The old Etruscan system of building, with much painted terra-cotta and with rude sculpture of a type which must have seemed to them very provincial and very archaic, too, when contrasted with the works of Greek civilization, could all be disregarded by men who had learned in the school of that civilization what the elegance, the finish and the perfect technique of Hellenic artists could produce.

Yet this influence is not to be avoided in view of the fact that all trace is lost of the republican buildings of Rome except some masses of the old Servian wall, the substructure of the tabularium and the like, which have kept their places by sheer inertia and on account of their immovable mass. The business of every Roman invader of the Eastern lands was to bring away as much artistical plunder as practicable, and on his return home to build great public monuments in the Imperial City itself as nearly in the Greek taste as he could. This again is an inference, but is irresistible in view of the abundant remains which we have of the period from 150 to 50 B.C., and of what is said about the period by its own writers. We have less power of judging of the buildings built in the provinces under Roman direction at this early period. Probably those buildings were not numerous nor often important. It was not until the civil wars had been closed and the peaceful administration of the empire was assured, first under the Dictator Julius, and

then under his nephew, Perpetual Tribune and Perpetual Prince of the Senate, Octavius, that Roman buildings, properly so called, because constructed in accordance with the central authority on the Tiber, appeared in the different parts of the Mediterranean world. It was in 54 B.C. that L. Æmilius Paulus began his great basilica at the northeast of the Roman Forum and intended as a second forum—an enlargement of the public space for the meeting of citizens. Julius (murdered in 44 B.C.) began his basilica, which was finished by Augustus, who also cleared away older buildings and built and adorned a new forum north of the Forum Romanum. The Forum of Augustus, with a triumphal arch, was more splendid than anything that had been seen in Rome. It contained the magnificent Temple of Mars the Avenger (Mars Ultor), and was enclosed by a lofty wall of solid cut stone masonry to shut off the humble dwellings to the north and east from the stately architectural group. The enormous Sæpta Julia, a larger basilica than any that had existed before, was built far to the north of the Capitol, in what was then the Campus Martius.

From that time on the emperors and the Senate vied with each other in the extent and magnificence of their buildings in the imperial city. These buildings were of two marked and easily distinguished classes. One class was Greek altogether in its tendencies, in the character of its construction and its design. It consisted of columnar architecture altogether, the construction being as simple as the Greek temples of earlier times. They were all of trabeated or post and beam construction, and always flat-roofed, always depending upon their colonnades for their chief architectural effect. The other class of buildings was of a nature never before seen in the world, and of unexplained origin.

It is very probable that the Alexandrian Greeks, that is to say, the Greek builders, under the successors of Alexander, and especially in the wealthy seaport city named after him on the shore of Egypt, invented this system of buildings, or rather developed it from the earlier practice of the Western Asiatics, especially the Persians of the later kingdom. This system of building was dependent upon vaulting in solid shells, either bricks or small stones being employed with what is called the "bath of mortar," that is to say, with mortar used in a semi-liquid condition and in great abundance. The result of this system of masonry is a solid, uniform, homogeneous shell, whether in walls or in the vaulted roof. It was taken over by the Roman builders at an early period of the rebuilding of the imperial city, and yet it is not ascertained at what period the earliest monuments of this style appeared in the city of Rome. It has been noted that Vitruvius, writing under the government of Octavius Augustus, never alludes to it. To him, the only writer on building of the time whose works have come down to us, building is as simple a matter as it was to a Greek; he seems to have understood only walls of brick or stone and roofs of timber. It is not possible to assert that any buildings of the character described above earlier than the Pantheon exist in Rome or in Italy, and the Pantheon as we have it, that is

ROMAN EMPIRE, ARCHITECTURE

to say, the cylindrical tower roofed with a low cupola 140 feet in diameter, and the largest structure of that kind in the world, is of the reign of Hadrian (117-138 A.D.). Once adopted however, this system of building prevailed immediately all over the empire, not universally, but as it seems, in the way of the officially recognized style of building whenever a spacious interior was required. And it is noticeable that this building for the interior is practically a Roman imperial invention. No Egyptian, no Babylonian or Assyrian, no Greek builder would have thought of making the interior the chief object of his care. The exterior of the monument was its essential characteristic; the interior, as is clear from the plans of the buildings, came of the necessities of construction without any serious attempt to modify them to the service of the requirements. The Roman engineer, on the other hand, desired vast halls, wide as well as long and high, and grappled with the problem of roofing these by means of masonry vaults, with a determined and seemingly unconscious courage unique in the history of the building art. Once he had developed the system of building the cylindrical or the spherical vault by means of stones laid in strong cement mortar, it seemed to be as natural to him to plan a width of 80 or 85 feet and to roof cylindrical towers nearly twice as wide, as to build the halls of more moderate dimensions.

These different systems of building were combined by the Roman engineers with extraordinary simplicity of means and with perfect success. Thus a massive wall built of squared blocks of stone without mortar exactly as would have been the practice in a Greek town four centuries earlier, would be backed up by a wall of mortar masonry. Bricks were used to face walls of solid masonry with such perfect success that those walls, of all thicknesses from nine or ten inches to many feet, were thought for years to be brick walls, although there is no such thing as an ancient brick wall in the city of Rome, and the solid mass of small stones laid in mortar and faced on either side with triangular tiles of clay exists even in the thinner partitions. Colonnades of marble shafts, capitals and epistyles were built in front of and flanking temples and palace halls, which were vaulted in the true Roman style with rubble laid in mortar, and these alternating with halls built and vaulted with almost equal boldness in cut stone as in the famous Nymphæum at Nîmes, in southern France. In making these combinations the Roman engineers were led inevitably to the mingling of their principles of design, and as they were not swayed by the strong logical and artistic sense of the Greek peoples they used this mingling of styles without perfect harmony. Thus a building of the most solid construction with all its openings spanned by arches and its roof made by a gigantic and ponderous vault would be adorned within and without by columns and entablatures, just as if the whole structure were Greek in the simplicity of its build. In later times separate columns were used to give a real or apparent support to the abutment of the vault. Thus in the great walls of the *Thermæ* (see *THERMÆ*) the groined vaults springing from nearly square piers are really supported by the walls themselves, from which the abutments project and

are supported generally in the way of corbeling: but in every case a gigantic column of Egyptian granite or similar precious material, with a capital of gilded bronze is put in to carry the line of the vault to the floor, and to give a seeming support even to that which needs none. This is the serious fault of the Roman imperial architecture, its denial in the decoration of the actual constructive nature of the work.

The Roman engineers did not look to the building itself for their final architectural effect. They used with the greatest freedom many kinds of surface decoration, ransacking the empire for splendid materials and using labor and money for the procuring of magnificent adornment. Thus a great hall in a public building would be lined with precious marbles in great slabs for the lower part of the walls; above this might come stucco surfaces modeled and embossed in reliefs of great beauty, such as those found in a tomb on the Via Latina near Rome, and very recently in a room in the Farnese garden near the Tiber. Above this again a similar finish in stucco would be carried out with deeply sunken panels and much gilding. The floor of such a hall would be of mosaic, and the pillars, whether square or circular, and the great pilasters which backed the free columns, would be of the most costly material and in enormous blocks. It is not asserted, however, that the building was designed by one artist and the decoration by another. On the contrary, the original scheme provided for all the decoration which was to be added. It is this freedom of decoration combined with an elaborate study of the interior as the chief purpose of the building, that has made the Roman imperial buildings the models from which all more recent architecture has originated. A Greek temple would be of no use as a Christian church, or as a palace hall—as a place of meeting or as a shelter for many persons; but the Roman buildings, basilicas, palaces, *thermæ*, and private houses, were all especially fitted to be lived in and otherwise used. The people of the West took the Roman buildings as they stood for churches and residences and buildings of state and official life; and as they built others, modified them from Roman practice only as their greatly diminished resources compelled them to do. A poor mediæval community could not build as a Roman proconsul built; the 6th century building had to be cheap and poor, with low, thin walls and a wooden roof: but still the Roman type was kept in view. In this way the Latin architecture of Italy, that of the earliest churches, took shape and was succeeded by the Romanesque (see *ROMANESQUE ARCHITECTURE*) for all of Europe except the Balkan Peninsula and the countries north of it. In the East another course was followed. The Roman civilization, and some part of the wealth and readiness to spend money which characterized the great empire, were retained in the empire of the East, and under these different conditions and with the powerful influence of Persia close at hand, the Byzantine architecture has lingered in the East until the present day, taking a different and generally inferior form in the hands of the Mohammedan race (see *SARACENIC ARCHITECTURE*), but preserving its original character where Greek Christianity has prevailed. In Western Europe, on the other hand, the

ROMAN EMPIRE, HOLY—ROMAN LAW

Romanesque architecture grew into Gothic; and the neo-Classic architecture followed in the 15th century, as a combination of the forms and structure which the Gothic art had made familiar to Europe, with a system influenced and largely controlled by the study of classical Roman art.

Of all the methods of architectural adornment, sculpture was the most remarkable; and the Roman architectural sculpture was a great contribution to the world's possessions of noble fine art. As early as the dictatorship of Julius, there existed in Italy a school of sculpture quite different from any matured by the Greeks. The great Altar of Peace, begun in 13 B.C. to commemorate the establishment of peace in the Mediterranean world, included a great amount of exquisite sculpture, both architectural and in the form of portrait statues. Under Trajan the art assumed a very dignified and truly architectural form, as in the reliefs of the Arch at Benevento and the still more admirable compositions preserved in the Lateran Museum at Rome. Under Marcus Aurelius large and showy reliefs recorded the transactions of his reign. The sculptures here named are all in marble, but the beautiful stucco reliefs must also be included in any examination of the sculpture of the 1st and 2d centuries.

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RUSSELL STURGIS.

Roman Empire, Holy. See HOLY ROMAN EMPIRE.

Roman Forum. See FORUM.

Roman Law. The time of Justinian represents the beginning of Roman jurisprudence, for while laws had existed since the days of Romulus, it was during his reign and by his direction that civil jurisprudence was at last digested in the Code, the Pandects, and the Institutes.

Originally the government of Rome was in the hands of an elective king, a council composed of nobles and an assembly of the people. Matters concerning war and religion were administered by the supreme magistrate, and he alone had power to propose laws, his suggestions being debated in the Senate, and, finally, submitted to the several parishes of the city for ratification or

rejection. Among the most famous ancient legislators were Romulus, Numa, and Servius Tullius. It was to Romulus, for example, that Rome owed its first laws concerning marriage, the education of children, and the authority of parents; from Numa it obtained its law of nations and of religion, while from Servius came the civil code which balanced the rights and fortunes of the seven classes of citizens, and provided for the protection of contracts and the punishment of crimes. Later these laws were codified under the title of *Jus Papinianum*, but the work has long been lost, fragments only having been found by archaeologists.

Wise as many of these statutes may have been they were not destined to last for long, and when they became both odious and obsolete they were succeeded by the Twelve Tables, a digest that was received with such blind reverence for authority that all young Romans were compelled to commit it to memory. For centuries this stood as the "fountain of justice," and it is possible that there would have been no change for centuries to come if the new laws had not become such an intolerable grievance, permitting an almost complete divorce between law and equity. Conceived by the genius of Caesar, it remained for Hadrian to find the solution to the difficulty in the compilation of the code which, known as the Perpetual Edict, long remained the standard of civil jurisprudence in Rome.

During the four centuries that elapsed between the day of Hadrian and the reign of Justinian both public and private jurisprudence were molded by the will of the sovereign, and the custom of placing his decision on the same level as the maturely deliberate acts of the legislature resulted in the adoption of so many general and special laws that obedience might be said to have become an impossibility, until, at last, the question of the will of the sovereign was fixed by the framing of the Gregorian, the Hermogenian, and the Theodosian codes. The last named laws were compiled by a commission of eight persons appointed by Theodosius the Younger in 429, but were not published until 438, when they were established as substitutes for all the existing codes made since the reign of Constantine.

In A.D. 527, when Justinian ascended the throne, he found that the reformation of Roman jurisprudence was a labor that could no longer be postponed. During ten centuries the laws and the legal opinions that had become statutes were so numerous that they filled many thousand volumes, making it impossible for anyone to obtain, to say nothing of digesting, all of them. Judges were, therefore, often compelled to exercise their own discretion in the absence of any known law, while citizens in general were practically in absolute ignorance concerning the laws that governed them. The new Code, the Pandect, or digest, and the Institutes, or elements, were prepared by the most eminent scholars, who worked under the direction of Tribonian, a man whose versatility of knowledge can be compared only to that of Bacon. The entire compilation was completed in three years, and the ancient statutes were at once abandoned as relics of antiquity. This code was simply a digest of the previous codes of Gregorianus, Hermogenianus, and Theodosius, and the Constitutions, Rescripts, and edicts which had previously been issued, and is of importance in that it contains much ancient church history and law.

ROMAN RELIGION — ROMANCE

Roman Religion. So composite was the body of the religious beliefs of the Roman people, and so complex the elements themselves of which this composition was formed that it is impossible to name any definite source from which it may have come. It consisted of a mass of mythological traditions and customs which may be traced back, in many instances, to several common localities. These beliefs were introduced from time to time by the various peoples who formed the successive accretions to the great Roman people, and who in every notable instance brought with them into the nation their national religious beliefs, contributing part of them at least to the permanent structure of the Roman religion. And yet there are certain native elements which may be regarded as distinctively Latin, while, on the other hand, these elements themselves are nearly always paralleled in some one, or even in several, of the foreign components. To the influence of the Greeks more than to any other people the Roman religion is indebted for its structure and general complexion. And yet it will be seen that it differed from that religion in fundamental, vital respects.

Regarding Romulus and his immediate successors as the primitive founders, it will be found that distinctive contributions from the Sabines were added to the beliefs of the early settlers, and these later supplemented by the Latin and the Etruscan. The host of lesser sources can not be stated with any degree of accuracy. As hinted above many of the Latin gods bear a striking similarity to the Greek—a fact accounted for by a common origin. Thus we have the Latin Saturn, god of seeds, fruition, akin to the Greek Kronos; and Ops, wife of Saturn and goddess of earth and plenty, akin to Rhea, wife of Kronos; Jupiter, and Juno, who might be related to the Greek Zeus. More distinctively Latin are the wood gods, Faunus and Fauna; Janus, Diana, the goddess of the hunt; Vesta, the goddess of the hearth (flame); Vulcan, the god of flame (the smithy); Fortuna, the goddess of fortune and of chance. The list is too long for enumeration. Deities which may be named as of Sabine origin are the war gods, Mars and Quirinus, the latter being more particularly a god of strife; Sol, Luna, and other gods of the heavenly bodies. Tellus, the god of the earth, was Latin, while Feronia, the goddess of the soil, was of Sabinian origin.

The Romans had a separate god, or more often sets of gods, for everything. Besides all the greater deities corresponding to the Greek beliefs there were gods and goddesses for all the lesser acts and conditions of life, for every material thing. Thus from their supreme representatives, Jupiter, Juno, and Minerva, to the Lares and Penates, the gods of the household, there was an endless procession of deities of every grade and power.

Worshipping at first directly and freely to these gods themselves the Romans maintained in their religious dealings with them a somewhat Norse-like independence. A god was to be worshipped for the good he would do one. Greater his return to his votary the greater the worshipper's respect and belief. The Roman struck a bargain with his god; for so much good done him he worshipped the god so much. If the god proved powerless the worship was withdrawn.

From this fine freedom in his religious belief, characteristic of the simplicity, the noble democracy, of the earlier days of the Roman people, there grew, coincident with the luxurious decadence of the empire, grave abuses which finally corrupted the entire tissue of the religion. There had been no priests at first. Only the fewest and simplest of attendants were devoted to the service of the gods. But gradually there were continual additions to these, until during the last days of the empire all that remained of the former religion was the groveling superstitious mysticism, zealously kept alive by avaricious priests, who levied for existence on the popular prejudices, debased morals, and superstitious fears. It was against such a state as this that the Apostle Paul took up his labors and against which Christianity finally prevailed, the last official recognition of the old beliefs going down under the proclamation of Constantine the Great, whereby the Christian religion was declared to be that of the state (312 A.D.).

Roman Steelyard. See BALANCE.

Roman Walls, four great walls built by the Romans in Great Britain. The first of these stretched from the Frith of Forth to the Frith of Clyde. It was built by Agricola in 80 A.D. In 83 he strengthened it by another wall, and in 139 Lollius Urbicus again built over the same ground, the wall being known as the wall of Antonius. These walls were built to keep back the northern barbarians, who in the form of Picts and Scots continuously menaced Roman rule in Britain. Hadrian, concluding that the walls of Agricola were insufficient for this purpose, built in the early part of the 2d century the famous wall that stretched between Newcastle on the Tyne and Solway. This wall, finished in 120 A.D., was 68 miles in length, and marked the northernmost limits of Roman territory in Britain after that date. It is known as the wall of Severus, since that ruler strengthened it in 209 by building a parallel wall a few yards above it. Consult Bruce, 'Roman Walls' (1855).

Romance, a fictitious narrative in prose or verse, the interest of which turns upon incidents either marvellous or uncommon. The name is derived from the class of languages in which such narratives in modern times were first widely known and circulated: these were the French, Italian, and Spanish, called the Romance Languages (q.v.). The treatment here given must omit any extended mention of certain isolated romances in the later Greek. A well-known example of such is 'Apollonius of Tyre,' at one time widely read in the west of Europe; transmitted to England, first probably in a Latin version, it was soon translated, and was employed by Shakespeare for the plot of 'Pericles, Prince of Tyre.' Nor can the limits of the subject admit of discussion of some few Latin works sometimes classed as romances, such as the 'Golden Ass' of Apuleius, of which use was made in 'Don Quixote' and 'Gil Blas.' For such, see articles on individual titles and authors, and the general articles on the Greek and Latin literatures. For general consideration the subject may be restricted to the Middle Ages. The finest of these romances still extant are of the 12th and 13th centuries. They may be divided into two classes—the popular epics

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(*chansons de geste*) chanted by the jongleurs and other strolling minstrels; and the more elaborate and artificial poems composed by troubadours and recited before aristocratic audiences.

The materials of both classes were more ancient lays of celebrated heroes, mingled frequently, especially in the German romances, with pagan myths, together with long connecting passages composed by the minstrels themselves. Hence originated a series of epics grouped around some renowned hero, and forming a cycle of romance. To the first class belong the German heroic poems and the Carolingian chansons; to the second the Arthurian legends.

Of the collection of the ancient German lays made by Charlemagne, nothing remains except perhaps the fragment of the alliterative 'Lay of Hildebrand,' now in the Cassel Library. It is supposed to have been written in the 9th century or even earlier. All the other manuscripts of German heroic poems are of much later date; none of them are earlier than the 13th and most of them belong to the 14th or 15th centuries. Of the 'Nibelungenlied' (q.v.) there are three copies belonging to the 13th century. In this epic Dietrich plays an important part; but the poems devoted to the simple Dietrich legend are only found in late transcripts or early printed editions, probably little later than the date of their actual composition. They represent, however, older lays, and these again still older, of equal or even greater antiquity by two centuries or more than the Cassel fragment. The language changed considerably in the course of these centuries, and the poems must have been entirely recast, rhyme being substituted for alliteration; but the change in the legend itself is immaterial. It can be traced in the Latin chronicles of the 10th and 11th centuries, and also by means of the 'Vilkina Saga,' an Icelandic prose work of the 13th century. These poems, as well as others on similar subjects, range from a few hundred to several thousand lines in length. Some of them were modernized by Caspar von der Röhn, and inserted in his 'Heldenbuch.' The completest collection is that in Heinrich von der Hagen's 'Altdeutsche Heldenlieder' (1855). Another poem closely connected with the Nibelungenlied is the Latin epic of Walter of Aquitaine, attributed to Ekkehard I., abbot of Saint Gall, who died in 973, and is said to have written it as an exercise in his youth. It is obviously a translation from a German poem, and is found in several manuscripts, none of them perhaps older than the 12th century. The 'Klage' ('Lament'), said by W. Grimm and others to be a poem of the 12th century, forms a sort of conclusion to the great German epic; and another poem, 'Biterolf,' is ascribed to the same unknown author. It extends to 13,000 lines, and contains a great number of daring adventures, in the course of which Dietrich encounters and vanquishes Siegfried. 'Gudrun' is a fine epic of nearly 7,000 lines, and is of not much later date than the 'Nibelungenlied.'

We can only mention the names of the poems which make up what has been called the Lombard sub-cycle, namely, 'König Ruther,' 'Wolfdietrich' (including 'Hugdietrich'), and 'Ot-nit,' which latter furnishes the materials for the French poem 'Hun de Bordeaux.' Frederick Barbarossa was a great admirer of Charlemagne, and collected all the accredited records of that

monarch. He patronized the minnesingers as the German representatives of the troubadours. At his great Mainz tournament were assembled not only the knights of Germany and France, but the poets also. Among those present was Heinrich von Veldeke, who imitated the 'Roman d'Eneas' in his 'Eneit,' an example quickly followed by the chief leading epic poets of Germany. Heinrich completed his poem at the Wartburg, the residence of Hermann, landgrave of Thuringia; and many other translations, among others that of the 'Roman de Troie,' were executed there shortly afterward. Another guest of the landgrave's was Wolfram von Eschenbach, author of 'Parzival.'

The *chansons de geste* form an interesting body of literature. The oldest of them are of great length, consisting generally of 20,000, 30,000, or even as many as 56,000 lines, grouped in sets (*tirades*) of from 20 to 200 lines, all ending with the same assonantal rhyme. Up till the middle of the 12th century the lines were of 10 syllables, but lines of 12 syllables, ending in consonantal rhymes, were gradually substituted. The romances were sung to the sound of a kind of violin (*vielle*), played with a regular bow. Many of the minstrels (*jongleurs*) were poor, wandering on foot from village to village, singing in the ale-houses, or at the public fairs and games; some were soldiers, such as Taillefer, who struck his first blow at Hastings. Later they became mere mountebanks. A number of them wrote their own chansons, while others bought them from their original authors, and adapted them to the taste of their audience. When a jongleur had thus procured a copy he took care to conceal it from his rivals. A few of such copies, little weather-beaten volumes, are still preserved, a noted example being the Oxford manuscript of the 'Chanson de Roland.' It was to the poets of northern and central France rather than to the troubadours of Provence that these poems were due. The *chansons de geste* are divided into three cycles—that relating to Charlemagne and his peers, the Arthurian, and the classical. The more antique the Charlemagne romances are the more they are devoted to the emperor, who is represented more as a majestic king and valiant knight than as the statesman we recognize him in history to be; at times he is depicted as being easily duped, avaricious, and capricious. Among such works are 'Girard de Viane'; 'Fierabras' or 'Fierabras'; and the 'Chanson de Roland.' The centre of the entire structure is the 'Arthurian Cycle.' In the lays of the Welsh bards, supposed to be as old as the 6th and 7th centuries, although no manuscript extant is of earlier date than the 12th century, Arthur and his companions are celebrated, but temperately, the element of the miraculous being absent. It is in the 'Historia Britonum' of Abbot Nennius (apparently written in Welsh in the 8th century, and translated into Latin afterward) that the legendary additions begin to develop. Of three or four centuries later date are the so-called 'Armoric Collections' of Walter, archdeacon of Oxford, from whom Geoffrey of Monmouth professes to translate, and in which the supernatural and marvellous elements largely prevail. The 'History' of Geoffrey was versified in French (1155-8) by Wace, a son of one of the Conqueror's followers. The 'Brut,' as this met-

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rical setting is called, contains about 15,300 eight-syllable lines, and adds a few details to the story of Arthur which do not seem, however, to have been Wace's own invention. The work was translated into English, and further amplified, by Layamon, about 1204. The 'Brut' of Layamon is composed of nearly 32,250 alliterative lines, or rather half lines. One of the most prolific of the Arthurian poets is Chrétien de Troyes (born about 1140).

One of the finest of the early French Arthurian romances 'Tristan' or 'Tristram,' was adapted by Gottfried of Strasburg, who left his 'Tristan und Isolte' slightly incomplete, about 1210. Other poems belonging to the cycle are the 'Morte Arthur,' a fine alliterative work of the 14th century; a Latin 'Life' of Merlin, in 1,529 hexameters, written about 1217; 'Li Biaus Desconneus,' a narrative of the adventures of Giglain, son of Gawain, written by Renauld de Beaujeu about 1200, and imitated by Wirnt von Gravenberg in his 'Wigolais' (about 1212). From France the Arthurian romance spread also into Provence, Spain, Italy, and the Netherlands, and was again transplanted into England.

The last of the cycles are the *classical*, in which the subjects are Alexander the Great and the Trojan heroes. The materials for the Alexandrine poems were found in an old Greek romance, written in Alexandria between 100 and 300 A.D., and known as the 'Pseudo-Callisthenes,' which was long read as authentic history, and of which there is still extant two Latin abridgments belonging to the 9th and 10th centuries. The most important romance on this subject is 'Le Romans d'Alixandre,' written by Lambert li Tors and Alixandre de Bernay in the 12th century; it contains upward of 20,800 12-syllable lines. This was the chanson that established the whole sub-cycle, and first brought the Alexandrine line into vogue and gave it its name. It concludes with the testament of Alexander and the lamentations of his 12 peers. Many French poets continued the subject. Consult: Paris, 'Histoire Poétique de Charlemagne' (1865); Grimm, 'Deutsche Heldensage' (1867); Goedeke, 'Deutsche Dichtung im Mittelalter' (1871); Cox and Jones, 'Popular Romances of the Middle Ages' (1871-2); Rhys, 'Studies in the Arthurian Legend' (1891); Paris, 'La Littérature Française au Moyen Âge' (2d ed. 1890). See also FICTION.

Romance, or Romanic, Languages, those modern European languages which owe their origin to the language of ancient Rome—the ancient spoken language, not the language of classical literature. The common or vulgar speech of the ancient Latin peoples, the *lingua rustica*, differed as widely from the language of Cicero, Virgil or Livy as does the dialect of Yorkshire or of the Scottish lowlands from the literary English of to-day: it had in a measure its own vocabulary, its own pronunciation, its own grammar and prosody. This vulgar tongue was in fact the primitive Latin speech before Latin began to be used for literary purposes, and some of the widest differences between classic Latin and the modern Romanic languages are discovered existing in the extant remains of archaic Latin speech. A glance at a page of literary Latin is enough to convince any one of the frequency of such terminations

of words as *us, um, am*, etc., none of which are ever seen in Italian or Spanish: in the most ancient specimens of Latinity that exist the final *s* and *m* are very frequently dropped; and there is strong reason for the inference that in common speech, even in classical times, not only *s* and *m* but other consonants—*t, d, and r* were either dropped or feebly pronounced: this is what we see in the French language. Again, words in common use among the early Romans, but which were obsolete in the Augustan age, reappear in the modern Romanic languages; examples: in ancient Latin speech *bucca* signifies mouth, but in literary Latin it signifies the puffed-out cheek: in the modern Romance languages the word derived from *bucca* means mouth; *minacia*, obsolete in the Augustan age, is revived in Italian, French, English, etc. (menace); obsolete *vitellus* reappears in French *veau*, English *veal*; *caballus*, nag, is the original of the word for horse in French, Spanish, etc. Though obsolete as regards literary use, such words lived on in the vulgar speech and so became current in the language of the Roman colonies everywhere. But this *lingua rustica*, called also in the Middle Ages *lingua romana*, to distinguish it from literary Latin speech, underwent great modifications and changes when it became the common speech of the Gallic, Germanic or Slavic peoples among whom it was introduced by the Roman conquerors, or who adopted it after they had overturned the Western empire. Thus arose the modern Romance languages, which are chiefly seven, namely: Italian, Spanish, Portuguese (with which is usually classed the Gallego, or language of Galicia), Provençal, French, Ladino (or Romansch) and Rumanian: the dialect of the Catalans is regarded as the southern Provençal: in all of these Romanic languages except the Rumanian, the principal foreign element is Germanic or Gothic: in the Rumanian language it is Slavonic.

Romance of the Rose, a celebrated allegorical poem, one of the most important literary compositions of the Middle Ages. It consists of two parts, the first part, comprising about 4,000 verses, was written before the middle of the 13th century by Guillaume de Lorris, and the other some 50 years later by Jean de Meung: this contains nearly five times as many verses as the first part. It is a poem of love, but it is also a satire on contemporary manners and a curious repertory of miscellaneous erudition. Guillaume de Lorris, in the introductory lines of the poem professes to set forth the whole art and mystery of Love in allegory, and the Rose is "the sweet guerdon of love": but commentators were pleased to give this not very obscure intent of the poet a mystical turn, and interpreted the Rose as signifying the divine gift of Wisdom, or the soul's state of Grace, or the state of Eternal Bliss, or even the Virgin Mary. The commingling of allegorical romance with social and political satire, history, science, economic theory, and in short with such encyclopædic erudition as existed in that age, offends the modern literary taste and is exceedingly tedious reading; but it suited exactly the taste of its time, and for more than two centuries was a classic.

ROMANES — ROMANESQUE ARCHITECTURE

Romanes, rō-mān'ez, George John, English scientist: b. Kingston, Canada, 20 May 1848; d. Oxford 23 May 1894. He was graduated in 1870 from Caius College, Cambridge, in 1874-6 worked under Burdon Sanderson in the laboratory of University College, London, and carried out important researches in nervous excitability. In 1879 he was elected fellow of the Royal Society, and in 1878 published, under the pseudonym "Physicus," a work entitled 'A Candid Examination of Theism,' in which he took up a somewhat defiant atheistic position. Subsequently his views underwent considerable change; he revised the 'Candid Examination,' and toward the close of his life was engaged on 'A Candid Examination of Religion,' in which he returned to theistic beliefs. His notes for this work were published after his death, under the title 'Thoughts on Religion,' edited by Canon Gore. Romanes was an ardent supporter of Darwin and the evolutionists, and in various works sought to extend evolutionary principles to mind, both in the lower animals and in man. He wrote very extensively on modern biological theories. His chief remaining works are: 'Animal Intelligence' (1881); 'Scientific Evidences of Organic Evolution' (Nature Series, 1882); 'Mental Evolution in Animals' (1883); 'Jelly-fish, Star-fish, and Sea Urchins' (1885); 'Mental Evolution in Man' (1888); 'Darwin and after Darwin' (1892-5); 'Examination of Weismannism' (1893); 'Mind and Motion, an Essay on Monism' (1895). In 1896 appeared a volume of 'Essays,' a selection from his 'Poems,' and his 'Life and Letters.'

Romanesque Architecture. The term is applied to any style which is assumed to have grown up immediately from the attempt of mediæval people to build as the Romans of the empire built: but it is generally used for the round-arched styles of Central and Western Europe, from the 6th to the 12th century, and as excluding the Byzantine style of the Balkan Peninsula. It is also very common to exclude the earliest Christian churches of Italy (see BASILICA; CHRISTIAN ARCHITECTURE). The word Romanesque is not very ancient, and its original meaning is rather "romantic" or "fantastic": but it was applied to architecture in imitation of the French use of the term *Roman* (fem. *Romane*), which was introduced into architectural terminology about 1835, and exactly in this sense, that is, to denote the pre-Gothic, round-arched architecture of Western Europe. Previous to that time the English writers had applied the word "Norman" to all round-arched English buildings except those few which they supposed to be of pre-Norman origin, and which they called "Saxon" or "Anglo-Saxon"; and as for the architecture of the Continent, such terms as "Lombard" and "Early Italian" were used, also "French Round-Arch" style, "German Round-Arch" style, and the like, or, in imitation of the German writers, "Byzantine," even when applied to buildings in the North. The term Romanesque is said to have been proposed by William Gunn, a clergyman and antiquarian, who died in 1841. It was taken up by better known writers, such as Whewell and Benjamin Webb.

The characteristic of the Romanesque style is the almost universal employment of the round

arch, and of constantly repeated attempts to use arched construction also in roofing churches and palace halls. The history of building in France and Germany from the 9th to the close of the 12th century is a constant series of attempts to vault wider and still wider aisles and naves, and the constant failure of those vaults, which either fell in ruins or needed to be tied and braced afterward in different ways. This came largely from the inferior mortar which was used, but, in general, from the poverty of resources of the small communities, secular and religious, and of the barons and princes of the time. Very little power of employing skilled labor existed, nor was there much skilled labor to engage; and, moreover, the means of transport were extremely inadequate, so that stones, however unfit for the purpose, had to be taken from the nearest quarry, and mortar had to be made up of such materials as were readily at hand. From this inadequacy of resources comes the constant use of heavy walls and deep-set windows, which in turn add a peculiar charm to this style. The church buildings might have been more permanent but for the constant attempt of the builders to raise the clearstory walls high above the aisle roofs, in order to secure large windows in the clearstory for the lighting of the whole interior. The higher these clearstory walls were made the more dangerous was the vault which they were to carry, and this because of the comparative difficulty of buttressing that vault when it reached a considerable height. There was also the desire to terminate the church at the east end with one or more semicircular apses, and as the churches grew larger and the aisle to be carried around the apse concentric with the inner and higher semicircular compartment, the difficulty of vaulting this aisle became almost insuperable. It was out of this two-fold necessity that Gothic architecture arose, the startling innovation of the vault depending upon the ribs for their security having changed all the conditions of the problem (see GOTHIC ARCHITECTURE).

Romanesque architecture lingered the longest in Western Germany because magnificent cathedrals had been built and were building along the Rhine in this style. The cathedrals of Mainz (Mentz, Mayence), of Speyer (Spire, Spires), Trier (Trèves), and Worms, and the great churches of Saint Michael at Hildesheim, and, at Cologne, of Santa Maria, in Capitolio, of the Apostles, and of Saint Martin, show a magnificent and complete system of church building founded on the round arch and on cylindrical vaulting, which had a strength sufficient to resist the Gothic innovation for a long time. In Central France there remains a whole series of churches roofed by cupolas circular in plan, rising from square compartments by means of pendentives. This type must be thought to have come from the Byzantine through Venice; there belong to it the cathedral of Angoulême, and the churches of Gensac, Roulet, Souillac and of Saint Front at Périgueux, which last, however, has undergone a ruinous restoration. Further south is the cathedral of Le Puy (Puy-en-Velay), a round-arched church of great beauty and picturesque effect: but indeed the whole centre of France contains churches of this character, either perfect or in a much altered state.

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The especial glory of the French Romanesque is in its exquisite sculpture. Such churches as the Abbey Church at Vézelay, the cathedral of Angoulême, the Church of Notre Dame La Grande, at Poitiers, and in the South, Saint Trophime at Arles, and the never finished church at Saint Gilles, display a wealth of sculpture unequalled at the time and never approached in its value as architectural decoration except by the Gothic sculpture of the next century. There is also a curious use of polychromatic effect in the external walls at this period. Especially in the centre of France a kind of mosaic of sandstone of different colors is used freely in large parts of the church; a good example being Notre Dame du Port at Clermont-Ferrand.

The Romanesque of Italy is represented by such admirable churches as San Zeno at Verona, San Miniato on the hill near Florence, the remarkable cathedral at Modena and, for the latest period, Sant' Ambrogio at Milan and San Michele at Pavia. There are also several superb Romanesque churches at Lucca, including the cathedral; and at Pistoja, north of Florence, three most interesting churches adorned with horizontal bands of black and white. This system of coloring is rather common, and is retained until the later or Italian-Gothic period. These churches are sometimes as rich in sculpture as the French buildings of the same period.

In England the style is far less elaborate and rich, but has an especial charm for those who know the long nave of Ely, the transept of Winchester and the nave of Peterboro Cathedral, or the admirable round church of the Temple in London and that of the Chapter House at Bristol.

The Low Countries are not rich in Romanesque architecture, but Belgium possesses in the Cathedral of Tournai one of the most magnificent Romanesque churches of which we have any record. The choir indeed has been rebuilt in a later style, but the crossings remain complete, with four lofty towers surrounding a central spire-like roof and a long nave with two stories of round arches.

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RUSSELL STURGIS.

Romanino, Girolamo, jē-rō-lā'mō rō-mā-nē'nō, Italian painter: b. Brescia about 1485; d. there 1565. He was a pupil of Feramola in Brescia and between 1509 and 1513 lived at Padua and Venice, where he studied the rich golden coloring of Giorgione, and learned the art of reproducing it in his own works. After completing (1519-20) four frescoes in the cathedral at Cremona, he returned to Brescia. All his pictures are remarkable for their skilful composition and splendid coloring, but in his

later works his tones become silvery, clear and cold and lose the warm lustre of Giorgione's sunset tints. He painted many altar-pieces, of which the most remarkable are 'Madonna and Child' and 'The Madonna with the Dead Christ' (in Berlin Museum); 'Adoration of the Infant Christ' (in the London National Gallery, a good example of this painter's manner); 'Nativity' (in the Church of San Giuseppe at Brescia); and an 'Assumption' (in the Church of Sant' Alessandro, Bergamo). He also painted some frescoes in the castle of Malpaga, near Brescia, the home of the famous Colleoni, the commander of the Venetian armies. There are some fine portraits by Romanino to be seen at Brescia.

Romanoff, rō-mā'nōf, the name of the reigning family in Russia, founded by Michael Feodorovich Romanoff: b. 1598; d. 1645. He was descended through his grandmother from the family of Ruric, the founder of the Russian empire, and came to the throne in 1613 by election of the boyars and the higher clergy. The early part of his reign was troubled by the Poles and by turbulent nobles. Western civilization gained an entrance into the country, and many foreigners, particularly Scotchmen, became naturalized. France tried to disturb the commercial monopoly of England in Russia. Michael was succeeded by his son Alexis and the male succession of the Romanoff family continued until the death of Peter II. in 1730, when the crown devolved upon Anne, Duchess of Courland, and continued in the succession of the female Romanoffs until the death of Elizabeth in 1762. The latter was succeeded by her nephew, the son of the Duke of Holstein-Gottorp, who ascended the throne as Peter III. and established the present dynasty of Romanoff-Oldenburg.

Romans, Epistle to the, one of the epistles of Saint Paul, the genuineness of which is as a whole undisputed, though the last two chapters have been suspected by some critics to be spurious. The Romans to whom it is addressed would seem to have been mostly Gentiles converted from heathenism to a judaizing form of Christianity. It is plain from the epistle itself that these judaizing Christians, whether of Jewish or Gentile blood, were already separated from the strictly Jewish community settled in Rome. The epistle was written from Corinth just before the year 58 A.D., which was the beginning of Paul's captivity. The argument of the Apostle is directed against the efforts of some teachers in the Christian community at Rome to enforce on the Gentile believers the obligations of the Mosaic law. These Judaizers maintained that to abandon the law was to proclaim license to sin: to which Paul replies that the sole and sufficient law of Christians is that they shall lead a new life in fellowship with Christ: this fellowship makes the new life possible: the law only commands, but gives not strength to obey. The argument is so full of allusions to and quotations of the Jewish law, both moral and ceremonial, that in the opinion of many critics those to whom the epistle is addressed must have been, not Gentiles, but Jews by race: hence the suspicion entertained regarding the genuineness of the last two chapters, in which it is plainly implied that the majority

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of those "Romans" were indeed Gentiles, not Hebrews.

Roman'ticism. The word "Romantic" is derived from the old Romanic or Romance languages, which were formed by a fusion of Latin as spoken by the common people of Italy with the native tongue of the northern barbarians who invaded that country. This Romance speech naturally assumed a variety of forms, but it reached its highest development in Provence, in southern France, where it became an important instrument of popular literary expression, especially during the 11th and 12th centuries. The compositions which appeared in this vernacular tongue were generally tales and ballads in which the adventures of knights in pursuit of honor, or in devotion to the Christian religion, or the enthusiastic deeds of chivalry, and the spirit of loyalty and reverence for women were portrayed. Another mark of this literature is the evident fondness for events that are strange, mysterious, and supernatural. The name "romance" then, first applied to the language in which those compositions were written, came afterward to refer to the prevailing characteristics which they displayed, as contrasted with the works written in Latin, which were termed "classical." During the 18th century, which delighted to term itself the "Augustan Age," and prided itself upon its purity and refinement of taste, the classical models and modes of expression were regarded as furnishing the only correct standards, while the literature and art of the Mediæval Period was regarded as barbarous, and the whole mode of thought and life to be characteristic of Dark Ages that were unworthy of the attention of a cultivated man. At the close of this century, however, and during the early decades of the 19th, a marked change manifested itself in the whole tone and tendency of the intellectual life of the time. This mental revolution, which is known as the Romantic Movement, affected all departments of thought, and all artistic and literary standards and modes of expression. From the first this movement showed a consciousness of its opposition to the generally received intellectual conceptions and prevailing artistic and literary standards of the time, though this contrast was less violently emphasized in England than in Germany and France. Goethe noted and commented upon the difference between the old tendency and the new, describing it as equivalent to that between the "diseased" and the "healthy"; while Schiller contrasted them as the "naïve" and the "sentimental." It was Friedrich Schlegel who first employed the terms "classic" and "romantic" to characterize this opposition. Since that time many writers have undertaken to define and explain the fundamental distinctions between these tendencies, especially as they express themselves in art and literature. The following points appear to be most significant: (1) The main marks of classicism are simplicity, directness, and nobility and perfection in achievement. In a classic work of art, there are no evidences of a lack of harmony between the ideas and the medium, no suggestion of something remaining that cannot be expressed. As a consequence, the personality of the artist is not expressed, the artist is lost in his work, which stands impersonal and objective. He does not show us his own attitude toward the subject-matter, his emo-

tional struggles and the play of his life. The Romanticist, on the other hand, puts himself into his work; it is no disembodied idea of beauty that he seeks to express, but his own personality, the longings, hopes, and ideals of a spirit that has a tendency toward the infinite, and which therefore can never express itself in any finite and objective medium. Classicism is thus always definite, objective, and complete, while Romanticism is always touched with subjectivity, and thus with a suggestion of incompleteness, which is due to the fact that it seeks to convey the mystery of spirit for which no objective mode of expression is adequate, and which therefore can only be symbolized and vaguely suggested. (2) As Romanticism endeavors to express what is strange and mysterious in the life of spirit, it naturally seeks its material in the past, and feels itself especially in sympathy with the Middle Ages, when the aspirations of the spirit, its love of adventure, and sense of the mysterious expressed themselves in quests for the Holy Grail, in crusades, and gallant deeds of chivalry and knight-errantry. Thus a sympathy with the past, a new interest in humanity as such, marks Romanticism. (3) Just because classicism sought to express the idea of beauty in definite and objective form, it was possible to lay down fixed canons of procedure and so to render the result formal, precise, and almost mechanical. Romanticism, however, aims to represent what is inner and subjective, and therefore necessarily protests against making art stilted and formal by the application of external rules and mechanical standards. Art, the Romanticists declare, must spring from the untrammelled expression of the free spirit of the man of genius. "The will or caprice of the poet," as Schlegel says, "admits no law above itself."

The Romantic Movement.—The romantic movement may best be understood if we regard it as a part of the general intellectual revolution of the 19th century, and as one in spirit with the historical and scientific spirit of modern times. The entire spiritual attitude of modern life, as contrasted with that of the 18th century, may be characterized as a new consciousness of infinite possibilities and boundless aspirations. The spirit knows itself as infinite, and is also conscious of the infinite task set for the individual through its own demand for expression and realization. The new tendency turns away in disdain from the mechanical conceptions and formal syllogisms in which the 18th century had self-complacently summed up the universe, it laughs to scorn the unintelligent and formal imitation of classical models that bases itself on ancient canons; it denounces the ethical principle of prudence; it declares that the infinitely mysterious law of life cannot be comprehended by the principle of self-love; it refuses to believe in a transcendent God. The new movement is thus romantic through and through, filled with a sense of mystery and wonder, with the love of adventure and discovery, and with the buoyant spirit of aspiration. As Wordsworth says: "In that dawning age 'twas bliss to be alive, but to be young was very heaven." This tendency to advance to new achievements manifested itself in many and various directions. In philosophy, it led to a new and fruitful attempt to comprehend in more adequate terms

God, nature, and the place and significance of man's life in the universe. The result of this is seen in the systems of Kant and the German idealists. On another side, the new interest in man and the affairs of man's life has given rise to the modern historical movement which has made its influence felt in every department of intellectual life. It is this historical interest, united with the Romantic spirit of adventure and discovery, that is the assertion of the confidence of Reason in itself, that has called into being the evolutionary sciences of nature. The concept of evolution has transformed the older view of nature, just as it did our view of man when it was earlier applied to illumine his social, ethical, and religious life. For evolution is just an attempt to explain the world by showing the relations between things as parts of a single process. It therefore always emphasizes organic relationships, and views things as parts or stages in a dynamic process, instead of taking each thing as something static, which exists in isolation as something in itself independent, and having only external relations to other things. The Romantic movement in art and literature must also be regarded as an expression in different fields of essentially the same intellectual and spiritual attitude that is shown in these other spheres of activity.

Romanticism in England.—In England a new spirit was perceptible in literature soon after the middle of the 18th century. This new movement, however, was not so intense or so fundamental in scope as its counterpart in Germany, which began a little later. For the introduction of a natural literature into England, expressing a sympathy with nature and an interest in the past, while disregarding the rigid canons of the Augustan Age, was in a way but the restoration of the healthy natural traditions that had expressed themselves in Chaucer and Spenser, in Shakespeare and Milton, and in the folk-songs and ballads, which were collected and edited by Thomas Percy in his 'Reliques of Ancient English Poetry,' in 1765. It was thus not marked by the keen sense of opposition to the prevailing system that characterized the tendency in Germany, and at a later time, also in France. Moreover, perhaps for this very reason, it did not penetrate so deep into the spiritual life of the people, or show its effects in all departments of intellectual life, as in Germany. It appears mainly as a literary movement, with which is connected some new tendencies in painting, and also as a revival of interest in Gothic architecture, which Horace Walpole did much to promote. But the movement did not involve a fundamental transformation of philosophical and scientific conceptions. This transformation came about at a later period during the 19th century, and was largely the result of the influence of German thought as represented by Coleridge and Carlyle, aided by Darwin's discovery and applications of the doctrine of evolution. The names of Gray, Cowper, and Burns, are usually placed among the English Romanticists, as well as those of Wordsworth, Coleridge, Southey, Byron, Shelley, and Keats. A little later we have the revival of interest in Dante, which culminates in the Pre-Raphaelite movement.

The Romantic School in Germany.—Lessing stands as the first to challenge the canons of the classic art and literature. Herder is at

once the pioneer of the modern historical method and one of the first to appreciate the value of what is natural and spontaneous in literature. Influenced no doubt by the publication of Percy's 'Reliques,' he made a collection of the folk-songs of Germany. In Goethe's 'Werther' and Rousseau's 'Confessions' we have two books of nearly the same date that show many of the marks of extreme Romanticism. The name of "Romantic school," however, is usually applied to a group of men whose main centre of activity was first at Weimar and Jena and afterward to some extent at Berlin and whose work extends from about 1775 or '80 to 1806. The main names of this school are the brothers Friedrich and A. W. Schlegel, the philosopher Schelling, Novalis (whose real name was Friedrich von Hardenberg), Ludwig Tieck, and the theologian Schleiermacher. The main result of this movement was philosophical and æsthetic, though it led to some important results in the way of historical investigations. Another group of men—Uhland, the brothers Grimm, von Arnim, J. Görres and Brentano, who represent a more distinctly literary movement with strong national characteristics—are often called the younger Romanticists, whose centre of activity was at Heidelberg, where their organ, the 'Zeitung für Einsiedler,' was published.

Romanticism in France.—We have seen that Rousseau may in a sense be called one of the earliest Romanticists. As a result of the Revolution and the prolonged Napoleonic wars, literature received little attention in France during the years that were most fruitful in Germany and England. Chateaubriand and Mme. de Staël are sometimes said to be the forerunners of Romanticism in France. But the tradition of classicism was strongly entrenched, and even Victor Hugo at first adhered to this standard. But in 1826 in the 'Odes and Ballads,' and in the following year in the preface to the play entitled 'Cromwell,' he declared his allegiance to Romanticism, and at once became the leader in a new cause into which he threw himself with all the fervor of his enthusiastic nature. Besides Hugo, the principal French Romanticists are Alf. de Musset, Ch. Nodier, George Sand, Th. Gautier, and Balzac.

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Romanus I., rō-mā'nūs, **Lecapenus,** Byzantine emperor: d. Island of Protea 948. He served in the imperial navy, and was in command of the Byzantine fleet on the Danube in 917, when hearing of the defeat of the army at Achelous,

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he at once set sail for Constantinople. His designs on the throne were furthered by his popularity with his sailors and the people, and after the marriage of his daughter, Helena, to Constantine VII., he rose steadily in power, and in 919 was crowned colleague with his son-in-law. He exercised so much influence over the latter as to make him the real ruler until 944, when Constantine, aided by the sons of Romanus, caused him to be carried off to the island of Protca, where he was forced to become a monk, while Constantine was proclaimed sole emperor.

Romblón, rōm-blōn', Philippines. (1) A province consisting of a group of islands in the Visayan Sea, lying east of Mindoro and south of Luzon; they are near the centre of the archipelago, and the most northern islands of the Visayan group; area, 515 square miles. The northern islands of the group form with the islands of Mindoro and Marindique clear, deep channels, much frequented by Philippine boats; the islands are also indented with well-sheltered inlets and bays. The majority of the inhabitants of the province are Visayans; some Negritos are found on the island of Tablas, and Manguanes in Tablas and Romblón. Civil government was established in 1901. Pop. 55,339. The islands constituting the province are as follows: (a) Bantón, the most northerly island of the group; the surface is rugged except in the southeast; the soil is sterile, and few crops are raised; the chief industry is the mining of gypsum, an excellent quality of which is found; area, 11 square miles; (b) Carabao, the most southern island of the province; its chief physical characteristic is a central cone-shaped summit, from which the land slopes regularly to the sea; it is heavily wooded, but not inhabited; area, 19 square miles; (c) Dos Hermanas, two islets of rock, separated by a channel two miles in width; area, one square mile; (d) Maestre de Campo, the most western island of the province; it is circular in shape, and mountainous with steep shores; it contains one small village on the east shore; area, three square miles; (e) Romblón, the third island in size, giving its name to the group on account of central location and mineral wealth; (f) Sibuyán, the second largest and most eastern island of the group (see SIBUYÁN), and (g) Tablas, the largest island (see TABLAS).

(2) An island of the province of Romblón, lying midway between Sibuyán and Tablas, on the route of steamers passing through San Bernardino Strait and Verde Passage; area 50 square miles. A central mountain range traverses the island from north to south, with spurs extending toward east and west. The chief occupation of the people is cattle raising; valuable deposits of quartz, marble, and slate are found and quarried; the marble is exported in large quantities. This island is the seat of government for the province.

(3) Pueblo, capital of the province of Romblón, situated on the northwestern coast of the island of Romblón, the largest town of the province. It has an excellent harbor, one of the best of the Visayan group; and is the commercial centre of the island. It has some old fortifications originally built to defend it from pirates. Pop. 6,764.

Rome, Ga., city and county-seat of Floyd County, picturesquely situated at the junction of

the Oostanaula and Etowah rivers, which at this point form the Coosa River. It is situated 72 miles northwest of Atlanta, 195 miles northeast of Selma, Ala., and 73 miles southwest of Chattanooga. Rome is on the Chattanooga, Rome & Columbus branch of the Central Railroad of Georgia, the Alabama division of the Southern Railway, the Georgia division of the Southern Railway, the Rome & Decatur division of the Southern Railway and the Rome Railroad division of the N. C. & St. L. Railroad. Both the Coosa and Oostanaula rivers are navigable.

Public Buildings.—Rome has many modern business blocks, handsome churches, and public buildings. Shorter University for Women is here located. It also has a United States post-office and court-house, besides opera house, fine school buildings, and national and state banks.

Industries.—There is a large and increasing trade here in cotton manufacturing and general merchandise. In the city and contiguous thereto are numerous cotton mills, planing mills, furniture factories, iron foundries, plow works, ice mill, cottonseed-oil mill, sash and door factories, and other smaller industries. The assessed property valuation of Rome is over \$6,000,000.

Government.—Rome was incorporated as a city in 1847, and is governed by a mayor and city council. It has an electric light plant and waterworks, and 12½ miles of street railway system.

Population.—The population in 1870 was 2,748; (1880) 3,877; (1890) 6,957; (1900) 7,291; (1910) 12,099. Including its suburbs, it had in 1910 at least 20,000 population.

Rome (Ga.), Engagement at, and Capture of. When Gen. Sherman was closing in on the Confederate army at Resaca he ordered Gen. Garrard to move with his cavalry division from Villanow toward Rome, to cross the Oostanaula and operate on Gen. Johnston's flank. On 16 May 1864, after the fall of Resaca, Gen. J. C. Davis' infantry division was ordered down the west bank of the Oostanaula to support Garrard, and Garrard was further ordered to leave his artillery at Farmer's bridge, eight miles above Rome, in charge of Davis, who was to rejoin his corps at Kingston, while Garrard made a rapid movement on Johnston's flank. Davis made a march of 15 miles on the 16th, and bivouacked a few miles from Farmer's bridge. Meanwhile Garrard had, on the 15th, driven the Confederate cavalry from Farmer's bridge, and pursued to within sight of Rome, but the force developed proving too large to engage, he returned to Farmer's bridge, on his way to Lay's Ferry, where he met Davis on the evening of the 16th. Davis determined to continue on to Rome, which, when he arrived there on the 17th, was held by two Confederate brigades. At 5 P.M. the Confederates advanced and drove in his skirmishers. Davis now brought up his entire division, deployed two brigades and held one in reserve. A severe contest ensued, which continued until dark, when the Confederates withdrew to their works and Davis threw up intrenchments. On the morning of the 18th he ordered an advance, and found the works in his front abandoned. He occupied Rome, capturing ten guns, valuable iron works and machine-shops, and a large amount of public stores.

His loss was about 150 killed, wounded, and missing; the Confederate loss, about 100 killed and wounded.

Consult: 'Official Records,' Vol. XXXVIII.; Van Horne, 'History of the Army of the Cumberland,' Vol. I.

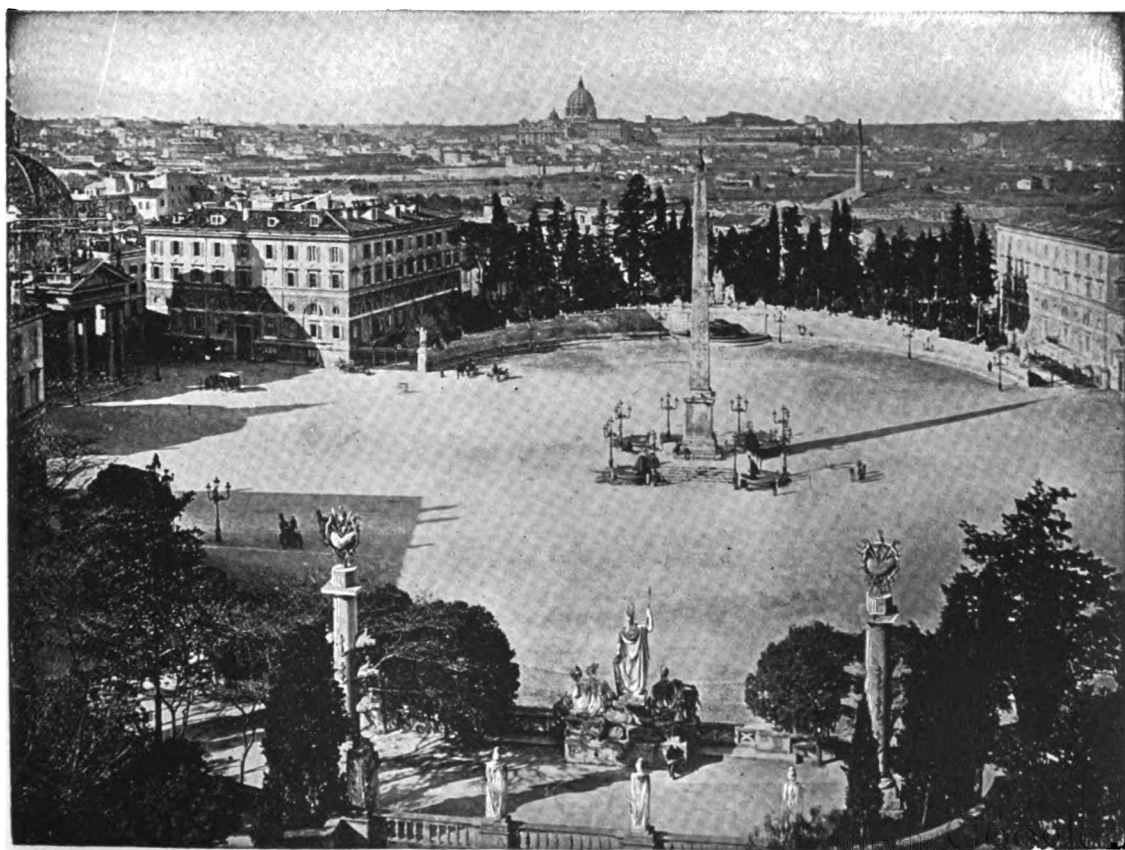
E. A. CARMAN.

Rome, Italy, the capital of the kingdom, as formerly of the Roman republic and empire, the Papal See, and long the religious centre of Western Christendom, is one of the most ancient and interesting cities of the world. It is traversed from north to south by the Tiber. Modern Rome embraces the ground, occupied by ancient Rome, on the left bank, besides an extended portion on the right, added during the rule of the Popes. A large part of the modern city stands on the flat plain known as the Campus Martius. The ancient city was enclosed by a wall, which at first embraced only the Palatine Hill, was built by Romulus, and had three gates. The second wall, attributed to Servius Tullius, enclosed all the hills, which gave to Rome the name of the City of the Seven Hills. This wall was built of huge blocks of stone without mortar. The third wall, the Aurelian (3d century), was built by the emperor whose name it bears, and had a circuit of about 11 miles. It had towers and bastions and 14 gates. It was not until the 17th century that Rome attained its present limits by a wall built under the pontificates of Urban VIII. and Innocent X. The walls are of brick and stone, and about 55 feet high, with 12 gates and several railway passages. The improvements of the modern city are suggestive of the new thought and practical endeavor of the age, yet the charm of beauty and dignity still lingers around the ruins and monuments of the ancient city. Extensive excavations have revealed interesting antiquities; those of the Forum Romanum and the Via Sacra; the remains of the temple of Saturn and of Castor and Pollux, the temples of Vespasian, of Antoninus and Faustina, the temple of Vesta, etc. Numerous villas and palaces and countless works of art have also been discovered. The Roman Forum lies between the Capitoline and Palatine Hills, and extends from the arch of Septimius Severus to the temple of the Dioscuri. It was surrounded by magnificent palaces, temples and basilicas. The Forum was originally a place where markets and courts of justice were held. It was open on one side and on the other was divided into corridors or halls containing the Exchange. This part was subsequently occupied by basilicas and temples. In 472 the Forum began to be the place of assembly of the Comitia Tributa. In the time of the Republic, public banquets and gladiatorial combats were held in the great Forum, which also contained various monuments, chief of which was the Columna Rostrata, erected in memory of the victory over the Carthaginians. The rostra, from which public orations were delivered, formed the boundary between the Forum in its limited sense and the Comitium. The Forum was under the Republic the centre of Roman political life. The Via Sacra was the main central street, skirting the Forum on one side, and passing by the Palatine to the arches of Titus and Constantine on to the Appian Way, the streets of tombs. The principal streets and squares of modern Rome

are the Piazza del Popolo on the north side near the Porto del Popolo, containing a fine Egyptian obelisk, from which diverge three of the great thoroughfares, the Corso, leading directly for one mile to the Piazza di Venezia, near the Capitol; the Via di Ripetta, which winds its course into a maze of ancient streets, and Via del Babuino, leading to the Piazza di Spagna, then further to the Quirinal, and passing through a tunnel, opens on the Esquiline; the aristocratic quarter lies between the Corso (lined with elegant modern palaces) and the Esquiline. Above the Piazza di Spagna, and approached by a noble flight of steps, is the Piazza de Trinità in front of the church of the same name, built by Charles VIII. in 1494. This eminence is the Pincio, the "hill of gardens," one of the historical seven hills, now a favorite promenade and once the site of the celebrated Gardens of Lucullus. The view thence of Rome is fine. The shaded walks are adorned by busts of celebrities. At the foot of the wall lies the Villa Borghese, containing objects of great interest, with its beautiful park, adjoining which is the Villa Medici, whose museum contains some rare antiquities. Other squares are: Piazza Barberini adjacent to the Palace; Piazza Colonna in the centre of the city, with a column of Marcus Aurelius, and nearby the Piazza di Monti Citoria, on which stands the Chamber of Deputies and other government offices; the Piazza San Pietro with its artistic colonnade, in front of Saint Peter's, and the Vatican; Piazza di Navona with a fountain and two churches. From Via Ripetta, two minor streets radiate, one to the Via Nazionale, the great business thoroughfare of the modern city and bordered by imposing and elegant buildings. From the Piazza del Indipendenza the Corso Vittorio Emanuele extends to the Piazza delle Terme and the ruins of Diocletian. All the railway lines converge at the Piazza dei Termini. The Via Cavour runs parallel to the Via Nazionale from the Station to the Capitol. The Piazza del Campidoglio in front of the Capitol contains the perfect equestrian statue of Marcus Aurelius, so celebrated as having Michelangelo's special regard. Other squares are the Piazza di S. Agnes, a martyred saint; Piazza di Navonna, containing the famous statue, a noble Greek work, of Pasquino (hence the term "Pasquinades") where for a long time satires of the day, directed against the Pope or nobility and prevalent follies, were posted; the Piazza di Montanari, where from time immemorial peasants contracted with land-owners for the season's farm-work. The Via Venti Settembre contains the immense palace of the Treasury, the war office, the Scotch church and school, many fine new edifices, and the British embassy, with its grand, old garden, the last remnant of the gardens of Papal Rome. In the new quarter, embracing the Esquiline, Viminale and a portion of the Pincian Hill, besides the Indipendenza, are the Piazzas di Dante, Vittorio Emanuele, Esquilino, Guglielmo Pepe, etc. Of the historical hills, the Capitoline, crowned with historical sites and fragments, claims our first attention. Upon it stands the modern Capitol, over the ancient Tabularium, which contained the tables of the laws, and is believed to have communicated with the *Æranium* in the temple of Saturn. "The beautiful Tarpeia," says Nie-



PIAZZA NAVONA, OR CIRCUS AGONALIS, ROME.



PIAZZA DEL POPOLO. ROME. ST. PETER'S IN THE DISTANCE.

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buhr, "still sits sparkling with gold and jewels, enchanted and motionless, in a cave in the centre of the hill." Thus the ancient Mons Tarpeia remains the treasure of art, the wonder of history. On the Capitoline, Numa founded a temple of Fides Publica and another to the god Terminus. Under Tarquinius Superbus, 535 B.C., was built the Temple of Jupiter Capitolinus, with money taken from the Volscians in war. This sumptuous fane had peculiar claims on the veneration of the Roman citizens—it was citadel and shrine, combined. The Sybilline books were preserved there. There both Titus and Vespasian celebrated their triumph over the fall of Jerusalem. It was later robbed of its treasures during invasions of the Vandals. Near it stood the temple of Fides and the twin temples of Mars and Venus Erycina. The temple of Jupiter Tonans was built by Augustus; the temple of Honor and Virtue by Marius in 103 B.C., with spoils taken in the Cimbric wars. There were still other notable temples, and the Altar of Jupiter Pistor, commemorating the stratagem of the Romans, who threw down loaves into the camp of the besieging Gauls to deceive them as to the state of their supplies. On this hill Petrarch received his laurel crown, and the tribune Rienzi promulgated new laws. Michelangelo designed the present Museum and Palace of the Conservatories, under Pope Paul III. (1544-50); Pius IV., Gregory XIII. and Sixtus V. added the sculptures, etc. At the foot of the Capitol is the ancient church of Ara-Cœli, the building at the back of the piazza is the Palace of the Senator, built by Boniface IX. (1389), but altered by Michelangelo. The ornamental fountain at the foot of the double staircase was erected by Sixtus V. The tower of the Capitol contains the great bell of Viterbo, taken in war; the view from this high point is superb. On the east side of the piazza is the Museo Capitolino, containing one of the finest collections of statuary and painting, and the famous mosaic, Pliny's Doves, found in the ruins of Hadrian's Villa near Tivoli. In "The Reserved Cabinet" stands the exquisite Greek statue Venus of the Capitol, found imured in a wall upon the Quirinal. In the Hall of the Emperors is the imposing seated statue of Agrippina (grand-daughter of Augustus); and 83 busts of Roman emperors, empresses and their families, a character study. Many of them are important as works of art. The Hall of Illustrious Men is interesting, as is also the Hall of the Faun, from the Faun found at Hadrian's Villa. The statue of the Faun is highly graceful and artistic. The three gems of the collection are found in the Hall of the Dying Gladiator, the Dying Gladiator, the Antinous of the Capitol, and the Faun of Praxiteles. On the west side of the piazza is the Palace of the Conservatories, which is to receive all the recently discovered antiquities. It contains busts of artists by Canova, the restoration of a column of Michelangelo, many fine frescoes and reliefs by Bernini and other masters; the Apollo Belvedere and the famous Bronze Wolf of the Capitol, of unknown antiquity. Near the wolf is the well-known and beautiful figure of the boy extracting a thorn from his foot. The Picture Gallery of the Capitol contains few good works: a beautiful Saint Sebastian by Guido, and several others by Guercino.

At the head of the Capitol steps, to the right of the terrace, stands the Palazzo Caffarelli, the residence of the German minister; the view commands the Forum and ruins as far as the Colosseum and to the Alban Hills beyond, where every stone has its story, from the Arch of Septimius Severus to the colossal Amphitheatre, embracing the remains of temples, arches, and royal palaces. The eight Ionic columns standing are a part of the temple of Saturn. At the right side of the Forum the remains of the Basilica of Julia, begun by Julius and completed by Augustus Cæsar, and just beyond are the three beautiful columns which belonged to a temple of Castor and Pollux, 484 B.C. Here costly sacrifices were offered and Roman knights richly decorated and crowned with olive, passed in military procession. The entablature supported by these columns is very rich and considered one of the finest specimens of Corinthian extant. On the right the Via Fienili branches off, leading to the Circus Maximus, with a capacity for 25,000 people (used for hunting wild beasts). The Palatine Hill, quite near, was the pivot of Rome's history, where the Pelasgic fortress was enclosed by Romulus, and where Augustus was born. This was the site of the Palaces of the Cæsars, pompous and magnificent beyond description. The temple of Apollo, of white marble, was the resort of poets. Close under the Palatine is the temple of Vesta, founded by Numa. Near was the Regia, whence Cæsar went forth to death. Adjoining the Basilica Julia is the Column of Phocas, sung by Byron. On one side of the Forum stood the Tabernæ Argentariæ, silversmiths' shops, and in front of Saint Adriano, beyond the Taverna Nuovæ, Virginia was stabbed by her father. The front of Saint Adriano is a fragment of the Basilica of Æmilius Paulus. This Basilica occupied the site of the famous Curia of Tullus Hostilius. The three gigantic arches still farther are all that remains of the Basilica of Constantine, one of whose classical Corinthian pillars was incorporated by Paul V. in Saint Maria Maggiore. Mediæval remains exist in a group of interesting churches in the vicinity. Little remains of the once superb temple of Venus and Rome, except a cella, countless fragments of columns, and a mass of Corinthian cornice facing the Colosseum. This was the last pagan temple which remained in use in Rome. Near the church of Saint Francesca the Via Sacra passes under the Arch of Titus, the most beautiful monument of its kind remaining in Rome, erected by the senate to commemorate the taking of Jerusalem. The gardens of Adonis, where Sebastian endured martyrdom, border an adjacent lane.

Between the Arch of Titus and the Colosseum the ancient pavement of huge blocks of lava remains. At the foot of the hill is the fountain where the gladiators used to wash. On the right the Via Triumphalis leads to Via Appia, first passing under the Arch of Constantine. This is the most striking of the Roman arches. The Colosseum or Flavian Amphitheatre was begun in 72 A.D. (12,000 captive Jews doing the work), and consists of four stories supported respectively by Doric, Ionic and Corinthian columns. Its circumference is 1,641 feet, length 287, width 182, height 157 feet, and it had the capacity to hold 100,000 persons. Its construction has been ascribed to Gaudentius, a Chris-

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tian martyr; it was used for gladiatorial combats, and those engaging were slaves or prisoners, or Christians who were compelled to fight wild beasts. Saint Ignatius was the first martyr here, devoured by a lion. Others were shot down by arrows, or exposed to every humiliation and torture. A cross marks the spot in the arena where Christians suffered. The upper arches frame a series of views of the Capitoline, the Cœlian, and the Campagna. Other triumphal arches not already mentioned are that of Severus and that of Drusus, 8 B.C. The Column of Trajan, very ornate in spiral bas-reliefs, illustrating the exploits of the emperor, by several thousand carved figures, and 117 feet high, is still standing. The Pantheon, by Agrippa, 27 B.C., a perfect specimen of classical architecture, is a temple to all the gods (now church of Saint Maria Rotonda) and the best preserved of all the ancient temples. It is circular in form and of remarkable construction, as regards its dome, by which it is lighted. The Catacombs are subterranean passages, extending many miles by winding passages underground, used as sepulchres and meeting places by the early Christians; niches in the walls of tufa were used to bury their dead. The passages are narrow, except occasionally when they open into wider spaces used for chapels of worship, and often frescoed. The decoration is characteristic and significant, usually representing Christian hope and doctrine. Pictures are frequently symbolic. A large collection of sarcophagi, pictures and inscriptions from the catacombs, are preserved in the Lateran Museum. The catacombs extend around the city in a wide circle; the most important are the Catacombs of Calixtus on the Via Appia; those of Domitilla or Saints Nereus and Achilleus; Saint Prætextatus, Via Appia; Saint Priscilla, beyond the Porta Salara; Saint Agnese, Via Nomentana; Saint Sebastiano, beneath the church of that name; Saint Alessandro; and the Jewish Catacombs and those of Mithras of the Via Appia.

Rome is par excellence the Mecca of artists, and both museums and Christian temples are the shrines of art. Rome is filled with churches, of which Saint Peter's ranks first. It was founded by Constantine on the site of the Circus of Nero, where Saint Peter suffered martyrdom, and is gorgeously decorated with gold mosaics and marble. Bramante, Raphael, and Michelangelo were the chief architects. Bernini filled it with the sculptures of his contemporaries and many monuments line the pillars and fill niches. The Pietà is one of the notable sculptures of Saint Peter's. The great dome is a marvel of architectural skill. The façade is 357 feet long and 144 feet high, and over the central entrance is the loggia, where the Pope is crowned and whence he gives his Easter benediction. Over the main entrance of the vestibule is the celebrated Mosaic of the Novicella (1208), by Giotto, and Cavallini. The magnificent central door of bronze is a remnant of the old Basilica (1431-9). The enormous size of statues and ornaments in Saint Peter's are deceptive as relates to the vast proportions of its interior, which is only realized by observing the moving, living figures of people. Around the shrine under the dome, 86 gold lamps burn continually. Wonderful mosaic pictures are

among the countless gems which enrich this noble temple. Its interior has the form of a Latin cross with chapels on the sides. Many princes of the church lie buried in the crypt. The Vatican, the present residence of the popes, is a vast collection of palaces, comprising the old and new palaces of the popes, the Sistine Chapel, the Loggia and Stanze, the picture gallery, museums and library. Raphael's wall frescoes rank above all his other work, and in the 'School of Athens' and 'Disputa,' the 'Transfiguration,' 'Driving Heliodorus from the Temple,' and other frescoes of the Stanze and Loggia, he evinces astonishing theological wisdom and philosophical erudition. Each stanza attests to his deep reflection and rich imagination; detail and general effect are equally studied, resulting in a perfect harmonious whole. In the Sistine Chapel, the 'Last Judgment' is Michelangelo's chef d'œuvre.

The Vatican Library contains 220,000 volumes and over 26,000 MSS. San Giovanni in Laterano, on a lonely site near the south wall, was built by Constantine, but has since been rebuilt, altered and extended by Giotto and others under various popes, and the high church councils are held there. Other churches are Santa Maria Maggiore, in whose construction antique bronzes, gold and marble from pagan temples were largely used, also beautiful mosaics of the 6th century. Santa Croce, erected by Saint Helena, the nave of which was borne by eight antique columns; Saint Clemente, the most perfect specimen of old basilica, contains frescoes by Masaccio; Il Gesu, the principal church of the Jesuits, with the façade and cupola by Giacomo della Porta, and whose interior is rich in marbles; Santa Maria degli Angeli, originally a part of Diocletian's Baths, transformed into a church by Michelangelo, an imposing church, contains an altar-piece by Muziano, and a fine fresco by Domenichino, and the tomb of Salvatore Rosa; Santa Maria in Ara Cœli, remarkable for its architecture and very old; Santa Maria in Cosmedin at the north base of the Aventine, remarkable for its Alexandrine pavement and its lofty and beautiful campanile of the 8th century; Santa Maria sopra Minerva, notable as the only Gothic church in Rome; Santa Maria in Dominica or della Navicella on the Cœlian, with 18 fine columns of granite and two of porphyry, and whose frieze of the nave was painted in Camiean by Giulio Romano and Perino del Vago; Santa Maria della Pace, interesting for its paintings, particularly the four sybils, considered among the most perfect works of Raphael; Santa Maria del Popolo, notable for its sculptures and paintings ('Jonah' by Raphael, ceiling frescoes by Pinturicchio, and mosaics from Raphael's cartoons by Aloisio della Pace); Santa Maria in Trastevere, an antique church, first mentioned in 449; and San Paolo fuore le Mura (on the spot where Saint Paul suffered martyrdom). In San Pietro in Vincoli is the celebrated 'Moses' of Michelangelo, by some critics regarded his best work of sculpture. The great baths or thermæ were peculiar features of the city and were used not only for bathing purposes, but for games and athletic sports, and contained assembly rooms, libraries, promenades, etc. The thermæ of Caracalla, Titus, and Diocletian were the most magnificent and largest. The great cloacæ (or



1. Facade of St. Peter's.

2. Interior of Basilica of St. Peter's.

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sewers) belonged to the Severan epoch. The Cloaca Maxima was the principal sewer. The aqueducts, built on rows of arches, thread the campagna for a distance of 60 miles, passing at times through hills and represent marvellous engineering skill. The Aqua Paola, Aqua Trajana and Aqua Marzia still remain, and contribute to the water supply of the city. Among the finest sepulchral monuments, the chief were the Mausoleum of Augustus in Campus Martius; that of Hadrian on the west bank of the Tiber, now the fortress of modern Rome, and known as the Castle of San' Angelo. The city was also rich in private palaces and buildings. The Naumachiae were artificial lakes constructed for fighting naval battles. There are ten bridges across the Tiber, besides the railway bridge. The highest is the Ponte Margherita, opposite the Piazza del Popolo; the Ponte di Ripetta, in the place where the old ferry was, to "the farm of Cincinnatus." (This bridge leads to the new quarter.) The Ponte Umberto, leading to the newly erected Palace of Justice or law-courts on the right bank; the Ponte Sant' Angelo, ancient Pons Ælius, leading to the castle. Below it is a new trestle-bridge; and still below this is the iron suspension bridge; farther, the Ponte Gianicolo, Ponte San Sisto; Ponte Garibaldi; then the two bridges which cross the island in the Tiber. The Villa gardens are fast being replaced by tenement houses and new suburbs are springing up. The University of Rome or Collegio della Sapienza is an ancient institution; canon law and civil law, medicine and philosophy and philology are included in its curriculum. It possesses extensive laboratories, botanical gardens and an astronomical observatory. It is attended by nearly 1,000 students. The Collegio de Propaganda Fide is situated in the Piazza di Spagna; the Collegio Romano, adjacent to Saint Ignazio, is a lyceum, and now contains the Archæological Museum and the recently established library, Biblioteca Vittorio Emanuele, combining the old Jesuit library with the libraries of suppressed monasteries, amounting to about 500,000 volumes. The Accademia de' San Luca, for the promotion of the fine arts, is composed of painters, sculptors and architects, and was founded in 1595. Connected with it are a picture gallery and schools of fine arts. There are numerous other institutions connected with art, music, science or learning, one of which the Accademia de' Lincei, founded in 1603 by Galileo and his contemporaries, is the earliest scientific society of Italy. Besides the libraries already mentioned, the chief are the Biblioteca Casanatense, the Biblioteca Angelica, and the Biblioteca Barberini. The American College was founded about half a century ago, is a school for priests and is composed of students who desire a post-graduate course in divinity, philosophy, rhetoric, metaphysics, etc. The students enjoy special privileges in the Vatican Library and museums and at all great church functions. There is also an American school of classical studies, under the auspices of the Institute of Archæology, whose work consists of archæological research and study, and whose investigations often lead the students as far as Greece or Egypt, accompanied by the faculty. The Irish College is the oldest in Rome, almost hidden by the famous Palazzo Aldobrandini, once the residence of Cardinal Mazarin. Other

famous palaces are the Palazzo Barberini on the Quirinal, built by Urban VIII., almost wholly from materials taken from ancient buildings. In its small but excellent collection is the 'Beatrice Cenci' by Guido Reni—also valuable MSS. and some literary curiosities; the Palazzo Colonna near the centre of the city; the Palazzo Corsini in the Trastevere, once the residence of Queen Christina of Sweden, and containing precious MSS.; the Palazzo Farnese, near the Tiber, was inherited by the kings of Naples, but now belongs to the French government, and is occupied by the ambassador. The Spada Palace is one of the finest examples of the late Renaissance; the Palace Rospigliosi, near the Palace of the Quirinal, contains valuable art treasures. On the ceiling of a casino in its gardens is the beautiful fresco of the 'Aurora' of Guido—this is now the residence of the French ambassador to the Pope; the Palazzo di Venezia is adjacent to the principal Jesuit church. The government buildings occupying former church property are the Post-office in the ancient convent of Saint Silvestro, the Ministry of Public Instruction in the convent of the Minerva. The porticoes or colonnades were public places of recreation or for the transaction of business. Among the basilicas, one of the most beautiful was the Æmilian on the north side of the Forum Romanum, 179 B.C.; the Basilica Julia, recently excavated on the south side of the Forum, begun by Cæsar, and the Basilica Porcia, the oldest, built by Cato, the censor. Recent excavations have thrown considerable light on the subterranean galleries, connected with the games held in the time of Cæsar in the Forum. It is clear that 12 elevators were used to deposit quickly the various parties of combatants. Equestrian statues were later placed above them. The square basement of Janus Medius, wells containing fragments of pottery, graves containing chalices, have also been discovered. Under the substructure narrow prison cells have come to light. At the foot of the Palatine were revealed the remains of an imperial palace, later transformed into a Christian sepulchre; also some prehistoric tombs. The ancient graffiti—that is the rough sketch or misspelled word scratched upon walls or columns by early Christians and thoughtless idlers, have solved many topographical problems of the ancient monuments of the "Eternal City." Among the Columns, the oldest was the Columna Mœnia, in honor of Mœnius who took the town in 338 B.C.; the Columna Rostrata, commemorating the victory over the Carthaginians 260 B.C. The most beautiful was that of Trajan in the Trajan Forum (described elsewhere), and a similar one in the Via del Corso near Palazzo Chigi. The most celebrated theatres are those of Pompey, Cornelius Balbus and Marcellus. The theatre of Pompey was adorned by the most beautiful Greek statues. It held 40,000 persons. The Colosseum as already described was the most magnificent amphitheatre. Hospitals of every description, some of which are richly endowed, are numerous. Church festivals are a special feature of Roman life, but the pomp and show of former times has somewhat diminished. External trade is unimportant. The chief manufactures are woolen and silk goods, artificial flowers, pottery, jewelry, mosaics, casts, and objects of art. Trade is chiefly in these articles,

and in olive oil, pictures, and antiquities. Pop. (1901) 462,783.

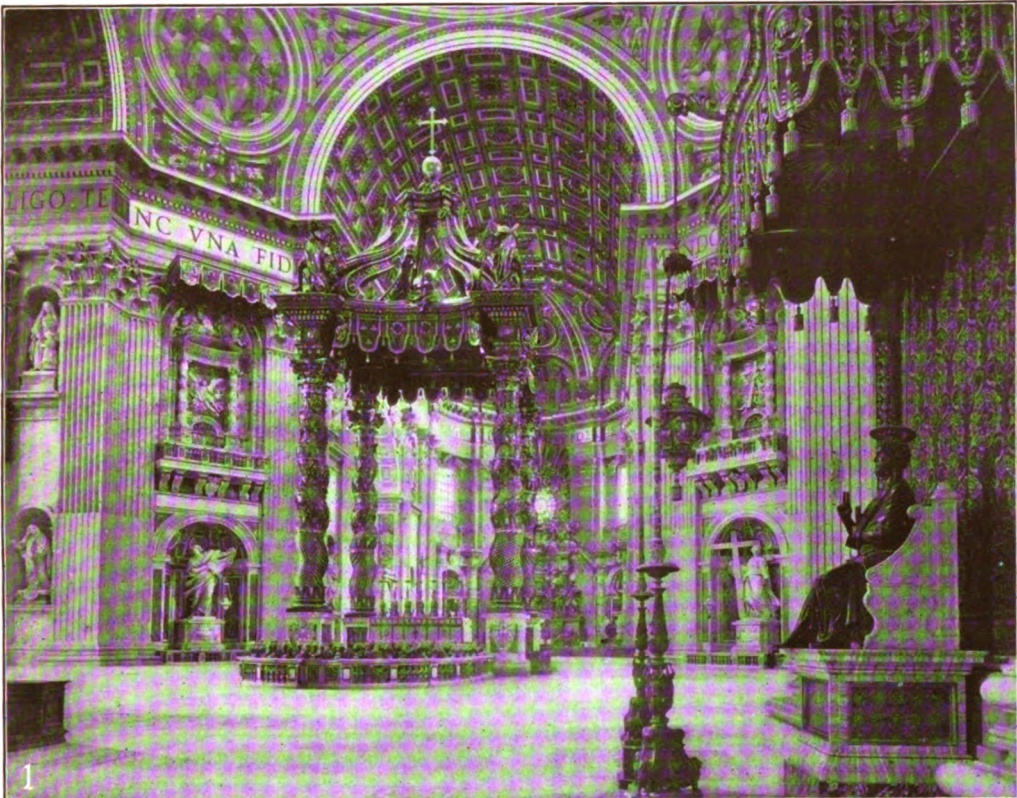
History.—Legend, accepted as authentic in later Roman times, made Romulus (q.v.) the founder of the city of Rome, and the Palatine, one of the seven hills that rise on the left bank of the Tiber, the site of the first settlement. The entire period from the date of the foundation of the city, 753 B.C., to the establishment of the republic, 509 B.C., is in its detailed history unknown to us, and from the mass of myth and legend it is possible to derive the very broadest conceptions only of the beginnings of the Roman state. This is due to the fact that the authentic records of Rome date only from 390 B.C., the year of the destruction of the city by the Gauls. Tradition, then, speaks of seven kings who, including Romulus, ruled over the city for 243 years and assigns to each definite services rendered to the state. Romulus was the founder and conqueror; his successor Numa Pompilius, was a religious teacher; Servius Tullius, a political reformer and law-giver, etc. The last three kings, Tarquinius Priscus, Servius Tullius and Lucius Tarquinius Superbus, were of Etruscan origin, whereas the earlier rulers had come from Latin stock. With the overthrow of Tarquinius Superbus in 510 the Roman kingship comes to an end. A critical study of this legendary period makes all these names and the events connected with them doubtful, but preserves the general outline of development. Rome, in the modern view, is regarded as having had its origin in the union of three tribes, the so-called Ramnes, Tities and Luceres, of whom the first were of Latin blood, the second of Sabine stock and the third of doubtful affinity. The situation of Rome on the hills near the mouth of the Tiber was favorable for its development, and in the course of time the city extended its authority over the neighboring country until with the destruction of Alba Longa, the ancient religious centre of the Latin peoples, it came to assume a predominant position in Latium. The Etruscan character ascribed to the last three kings points to an Etruscan conquest, and indeed throughout the early period of Rome the influence of the Etruscans to the north is marked, especially in religious customs and in architecture. From the very earliest period the inhabitants of Rome appear to have been divided into two classes, the patricians and the plebeians or *plebs*, with whom probably may be ranked the class of *clients*. It was the patricians alone that constituted the state; the *plebs* had no political rights whatsoever. In fact early Rome should be regarded as consisting of two isolated communities, one comprising the original settlers or, possibly, the conquerors of the city, the other the conquered population and later immigrants, such as those attracted to Rome by the excellent opportunities for trade it offered. Not only was the political power in the hands of the patricians, but even the early Roman religion was largely in the nature of a narrow national creed to which the plebs could not be admitted. Inter-marriage between members of the *populus* and plebeians was forbidden. The patricians alone had the right to bear arms. Within the *populus* or state, the headship was vested in the *rex* or king, who combined in himself the functions of war leader, judge and priest, and was

assisted by a council of elders or senate. The Roman "people" was divided into wards, class or *gens*, and households. When assembled for the exercise of its sovereign powers it was known as the *comitia curiata*. A change in the relations between patricians and *plebs* was effected by a reform which legend ascribes to Servius Tullius. By this innovation the right of bearing arms was conferred on the *plebs*, and the entire free-holding Roman community was divided into five classes, on the basis of wealth. These classes were subdivided into centuries or "hundreds," and the entire military assembly of the inhabitants bore the name of *comitia centuriata*, which, instituted undoubtedly for purposes of national defense, soon came to exercise important political powers.

The expulsion of Tarquin was followed by long wars with the Etruscans and the Latin tribes, in the course of which Rome for a time had to contend for its existence. A great victory over the Latins in 496 led to the formation of a Latin Confederacy under the leadership of Rome. Thus strengthened the Romans fought successfully against the Æqui, the Volsci and the Sabines, and in 396 captured the Etruscan stronghold of Veii, which was followed by the subjugation of southern Etruria.

The place of the kings was taken after 509 by two consuls, elected by the *comitia centuriata* from the ranks of the patricians. The institution of the senate was retained and plebeians were admitted to membership, but all magisterial offices were closed to members of that order. The period that follows, therefore, is marked by a bitter struggle on the part of the plebeians for political and, to a degree, social equality. Wealth, too, became concentrated in the hands of the patricians and the distribution of the public lands was carried on entirely in the interests of the ruling class. Discontent was also fostered by the severity of the laws against debtors. In 494 the plebeian army, just returned from a victorious campaign, seceded to the Sacred Mount, near Rome, and threatened to found a city for themselves unless concessions were made. The patricians yielded and the office of tribune of the plebs was created for the defense of the interests of the lower order against the ruling class. These tribunes, originally two in number, later increased to ten, were given the right of veto on the decisions of the consuls and the senate. In the course of the struggle for an equitable division of the public land, Spurius Cassius, a patrician who espoused the cause of the *plebs*, fell a victim to the vengeance of his caste (486 B.C.). The demand for a codification of the laws led to the appointment in 451 of ten Decemvirs who after two years' work brought forth the Twelve Tables in which the entire system of public and private law was embodied. The act of violence attempted by Appius Claudius, head of the Decemvirs, on the plebeian maiden Virginia led to the overthrow of the Decemvirs in 449 B.C. Protected now against the arbitrary misuse of the law on the part of the patricians, the plebeians pursued with renewed strength the struggle for political and social equality. In 445 inter-marriage between patricians and plebeians was made legally valid. The consuls were supplanted by military tribunes with consular power who might be chosen from among the plebeians. After this the plebeian

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1. Interior of Saint Peter's.

2. Interior of Saint Paul's.

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conquest of offices proceeded steadily. The quaestorship was gained in 421 B.C., the dictatorship in 356 B.C., the censorship in 351, the praetorship in 337. After a ten years' struggle it was provided by the so-called Licinian Rogations (367 B.C.) that no citizen should own more than 500 *jugera* of the public domain and that the remainder should be distributed among the plebs in small allotments. The consulship was also restored and it was made obligatory for one consul to be chosen from the plebs. By the year 300 complete equality between the orders had been established. The termination of the contest between the two orders may be assigned to the year 286 B.C., when the Hortensian Law made any decree of the *Comitia Tributa*, wherein the plebs were predominant, law for the whole people, the so-called *plebiscite*.

The course of political progress during this period was sharply interrupted by the invasion of the Gauls who in 390 overwhelmed a Roman army on the Allia, burned the city and besieged the garrison in the Capitol. Legend ascribes the defeat of the Gauls to Camillus (q.v.), but in reality it was a large ransom in gold which induced the conquerors to retreat. The devoted patriotism of its citizens, however, restored the fortunes of the city; its houses were rebuilt, the attacks of the neighboring peoples, the Volsci, the Æqui and part of the Latini were repulsed, and within a short time Rome had more than regained its former power. With the establishment of internal peace, its career of rapid conquest begins. The Samnites, the most formidable rivals of the Romans, were defeated in three great wars (343-341, 326-304, 298-290) in the course of which Rome contended successfully against the united forces of the peoples of central Italy, aided in the last of the wars by the Gauls. A rebellion of the Latins was crushed in 338, the long struggle terminated in the complete subjection of the allies, and the inhabitants of Samnium, Picenum, Umbria, Apulia, Lucania and Etruria became the allies of Rome. In 280 war broke out with Tarentum, the most powerful of the Greek cities in southern Italy. Tarentum called Pyrrhus (q.v.), king of Epirus, to its aid. Subjected at first to defeat, the Romans ultimately drove Pyrrhus from Italy and took Tarentum (272). Rome was now mistress of central and southern Italy and had fought with success against the Gauls in the north. To make conquest permanent military colonies were planted in the subjugated territories and a great system of public highways was developed to facilitate communications. The incessant wars had made Rome a nation of soldiers, and now that there was no one to resist it in Italy, it turned its arms against a foreign power, and in the struggle with Carthage made the first beginning of its imperial career.

The early relations between Rome and Carthage were friendly and commercial treaties between the two nations had been concluded at various times. The contest between the two broke out in Sicily, of which the Carthaginians were masters in greater part. The first Punic War (264-241 B.C.) began with the invasion of Sicily by a Roman army. The strength of Carthage, however, was on the sea, and to cope with it, the Romans built a fleet with which in 260 they gained a great victory at Mycæ. The fortunes of the war wavered for

a long time until a second victory off the Ægæan Islands in 241 brought Carthage to terms. Sicily was surrendered to the Romans who erected it into their first province, and Carthage pledged itself not to wage war on the allies of Rome. In 238 the Romans seized Sardinia and in the following year extended their sway over the Illyrian coastlands and upper Italy. Carthage, robbed of its island possessions in the Mediterranean, more than made up its losses in Spain; and in 218 B.C. the celebrated Hannibal (q.v.), son of Hamilcar Barca, the conqueror of the peninsula, renewed the contest with Rome (the second Punic war) by his attack on Saguntum, a city ally of Rome. Hannibal invaded Italy, overthrew the Romans at the Trebbia (218), on Lake Trasimenus, in the following year, and in 216 at Cannæ, where the rout of the Romans was complete. Rome, however, remained steadfast with Hannibal at its very gates, husbanded its resources and by carrying the war into Africa forced Hannibal to depart from Italy. In 202 the Carthaginian general was defeated by P. Cornelius Scipio at Zama, and Carthage signed peace giving up Spain to the Romans, dismantling its navy and paying an indemnity of 10,000 talents. The hatred of Rome, however, was not appeased, and when Carthage, after 50 years, showed signs of renewed strength, it was attacked and destroyed (146), after a siege of three years (the third Punic war). The Roman arms in the meantime had also conquered the East. Antiochus III. of Syria was defeated in 190 at Sipylus and deprived of his possessions in Asia Minor. Macedonia, after repeated wars, was made a Roman province in 146, and Greece, which had enjoyed the shadow of freedom for 50 years was reduced to the same condition, in the same year, under the name of Achaia, after Corinth, its most prosperous city, had been stormed and robbed of its art treasures. In 133 Rome fell heir to the dominions of Attalus, king of Pergamus, and the province of Asia was formed out of the territories thus acquired. The Roman rule in the Spanish peninsula was firmly established after two formidable insurrections, one led by Viriathus (148-140) and the other known as the Numantine war (143-133), had been suppressed.

Republican Rome was now at the height of its power, but the wars which had been crowned with such success abroad brought on evils within the state which were destined to destroy it. The task of governing a world empire and carrying on the great game of diplomacy by which that empire had in large measure been built up, naturally called for a more centralized and rapid exercise of authority than was possible with the cumbrous methods of the popular *comitia*. The power of the state gradually passed into the hands of the senate. There grew up at the same time a nobility of the robe, consisting of those who had enriched themselves as rulers of the newly conquered provinces which Rome for a long time regarded as subject territories merely and as fruitful sources of revenue. So wealthy had the state become, indeed, that in the second half of the 2d century B.C. the citizens of Rome were freed from all burdens of taxation, a measure which attracted to Rome a large population of idlers, which derived its chief sustenance from the largesses of the nobles who

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found it necessary to court the favor of the mob. Throughout Italy the rich Roman office holders established vast landed estates, which were fast coming to be worked by slaves, and the poor farmers, ruined by this formidable competition, came in great numbers to Rome to swell the ranks of the propertyless. Between this great mass of poor proletarians and the small class of officials, senators and landlords, strife was in the nature of things bound to come, and it was this strife between the *Optimates* or the aristocratic party and the *Populares* or proletarians that, skilfully used by ambitious politicians, brought about the fall of the republic. Noblest of the popular champions were the brothers Tiberius and Caius Gracchus (q.v.) who wrested from the senatorial party an agrarian law favorable to the homeless masses and regained some of the ancient powers of the popular assemblies, but fell victims both to the hatred of their enemies (133 and 121). The war against Jugurtha (q.v.), which revealed the shameless corruption to which the ruling party had sunk, brought forth another popular leader in Marius (q.v.), whose reputation was increased by the splendid victories over the Cimbri and the Teutones in the years 102-101. Moderate at first in his views, Marius was driven, by the agitations of demagogues, to violence. In 90 B.C. the Italians rose in insurrection to enforce their demand for the rights of Roman citizenship, and though the allies were defeated it was deemed expedient to grant them their demands. The termination of this struggle, known as the Social war, in 88 B.C., was followed by a conflict between Marius and Sulla (q.v.), an adherent of the senatorial party, for control in the state, in the course of which both factions were guilty of dreadful excesses. In the year 81 the Marian party was finally overthrown, and Sulla, proclaimed dictator, enthroned himself in power by a bloody proscription of his enemies, and proceeded to revolutionize the constitution of the state so as to place the sole power in the hands of the senate and the aristocratic party. But neither senate nor people was thenceforth to govern in Rome. The example of aristocratic rule based on military force had been set by Sulla and the struggle between parties now passed into a struggle between individuals for control. Gnaeus Pompeius (q.v.) by his victories over Sertorius in Spain and the suppression of the servile insurrection under Spartacus attained immense popularity and this was increased by his readiness to make concessions to popular demands. After his triumphant campaigns against the Mediterranean pirates and Mithridates (q.v.) he was for a time master of Rome. The senate, however, stirred to an assertion of its rights by its successful course in the conspiracy of Catiline (q.v.) now set itself to oppose his will and Pompey, desirous of redeeming the promises made his veterans of allotments of land in Italy, joined with Gaius Julius Cæsar (q.v.) and Licinius Crassus (q.v.) to form the first Triumvirate which for a time was absolute in Rome (60 B.C.). Cæsar was a leader of the popular party and he aimed at becoming the sole power in the state. Crassus died in 53, and in 49 war broke out between Cæsar and Pompey. The former had under his command a splendid army trained by years of campaigning in Gaul and

Britain and in the battle of Pharsalia (48) Cæsar was victorious. Pompey fled to Egypt and there perished and the remnants of his party were wiped out at Thapsus in 46 and Munda in the following year. Cæsar was now undisputed master of the empire, but fell, after a short rule, beneath the daggers of Brutus and his associates, and his death was followed by the renewal of civil war. Gaius Octavius, Cæsar's nephew and adopted son, and Marcus Antonius, Cæsar's lieutenant, both aspired to be his successor, but joined in 43 with Aurelius Lepidus, in a second Triumvirate to overthrow the party of Brutus and Cassius. This was accomplished at Philippi in 42, and Octavius and Marcus Antonius, setting aside the weak Lepidus, divided between them the Roman world. But while Octavius governed his western realm with energy, Marcus Antonius gave himself up to the pleasures of Cleopatra's court. War broke out between the two and in the naval battle of Actium (31) the forces of Marcus Antonius were utterly routed. Antonius fell by his own hand and Octavius was left without a rival. With Actium begins the Roman empire.

Octavius made no change in the established forms of government. In 27 B.C. the senate conferred on him for life the government of all those provinces whose defense called for the employment of the military forces of the empire, together with the supreme command of the army and the title of Augustus. Successively Augustus united in himself the great offices of the state, the consulate, the tribunate, the headship of the sacred colleges. The senate was left with the splendid shadow of power, in reality the mere instrument of the emperor's will. The empire, and especially the provinces, found peace after a half century of civil strife and acquiesced in the rule of an autocrat whose sway was far more kindly than the selfish rule of an aristocratic oligarchy. Under Augustus the economic development of the empire made rapid progress; its parts were brought more closely together by increased means of communication; with peace came also rapid intellectual growth, and Latin literature had its golden age in the reign of Augustus. The boundaries of the empire were extended to the north by the campaigns of the emperor's stepsons Tiberius and Drusus, who carried their victorious arms to the Danube and beyond the Rhine. The last years of Augustus' reign were darkened by domestic unhappiness and the great disaster of the Teutoburg Forest where Varro's legions were annihilated by the Cheruscan chief Arminius. Augustus was succeeded in the principate by his stepson Tiberius (14-37 A.D.) who ruled ably in the beginning but hardened with time into a gloomy despot whose suspicions fell heavily on all those members of the nobility who might in any way become rivals for power. Living in retirement on the island of Capræ he left the government to powerful ministers, of whom Sejanus (q.v.) is the most celebrated. Caius Caligula (37-41) a madman and a tyrant, was murdered by his guards and was followed by Claudius (41-54) a good-natured dotard who was completely under the control of his infamous wives, Messalina and, after her, Agrippina. By the latter he was poisoned and Agrippina's son, Nero (54-68), succeeded to the throne. After giving the fairest promise for some years, the young

emperor, in spite of such advisers as Seneca and Burrus, entered upon a course of infamous excesses and mad escapades which disgusted alike the senate and the army and brought about a revolt before which Nero fled. Unable to escape he killed himself, the last of the Julian house of emperors.

Galba, Otho and Vitellius, military rulers all proclaimed by their respective armies, fell within the space of two years and were succeeded by Flavius Vespasianus (69-79), commander of the legions in the east. Vespasian introduced economy into the government, brought to an end the Jewish war by the storming of Jerusalem (70) and began the conquest of Britain. The brief reign of his son Titus (79-81) was marked by the eruption of Vesuvius which overwhelmed the cities of Herculaneum and Pompeii (24 Aug. 79). The reign of Domitian (81-96), a younger brother of Titus, was a period of oppression and intellectual stagnation. Cruel, despotic, half-mad Domitian resembled the last rulers of the Julian house rather than the great emperors whom he succeeded and by whom he was followed. Nerva (96-98) was succeeded by M. Ulpius Trajanus (98-117), under whom the empire attained its greatest extent. His campaigns north of the Danube resulted in the erection of the province of Dacia; Armenia and Mesopotamia were acquired and the Parthians were driven back from the Euphrates. Hadrian (117-138) had none of the warlike instincts of his predecessor, but he devoted himself to the task of organizing the affairs of the empire, and better to acquaint himself with the condition of the various provinces he made long and repeated journeys embracing every part of the Roman dominions. Hadrian was succeeded by the philosopher-emperors Antonius Pius (138-161) and Marcus Aurelius Antoninus (161-180), in whom were exhibited the highest and fullest development of the Pagan character, and though the reign of the latter was disturbed by wars against the Parthians and the peoples of the Danube, it was of this age of the Antonines that an eminent historian speaks as the happiest era in the entire course of European history, if the welfare of the great mass of the population be considered.

With the death of Marcus Aurelius the decline of the empire begins. On the north the Germanic peoples were threatening the Roman frontier and on the east the new Persian kingdom arose as a formidable adversary. Commodus (180-192) neglected the affairs of the empire to win the laurels of a gladiator and was murdered by some of his followers. The Prætorian guard now appears as the maker of emperors. It deposed Pertinax who had been chosen by the senate and sold the throne at auction to the Senator Didius Julianus. The armies of the provinces arose and three claimants for the throne appeared. The successful candidate Septimius Severus (193-211), successful by force of arms, ruled well and sought to repress the power of the Prætorians. The reign of his son Caracalla (211-217), one of the most vicious tyrants in Roman imperial history, is noteworthy for the extension of the rights of Roman citizenship to all free inhabitants of the empire. Caracalla was assassinated by the Prætorian prefect Macrinus, who was speedily succeeded by Heliogabulus (218-222), a priest of

the sun at Emesa. Heliogabulus brought with him to Rome the orgiastic rites of the Orient and became the object of national hatred and contempt. He fell at the hands of the Prætorians, who chose as his successor Alexander Severus (222-235) who ruled with fair ability but perished in a mutiny of the German legions. There followed a period of confusion in which the decline of the empire was rapidly accelerated. Maximinus (235-238), a Thracian by birth and a soldier of fortune, crushed his rivals, the two Gordiani, but fell in battle against the forces of the senate. Balbinus and Maximus, chosen by the senate, were slain by the Prætorians, and Gordianus III. ruled from 238 to 244. He was followed by Philip the Arab (244-249), Decius (249-251), Gallus (251-254), Valerianus (254-260) and his colleague Gallienus (254-268). Valerian was defeated by the Persians and taken prisoner and on the ensuing anarchy usurpers arose in every province, known collectively as the Thirty Tyrants. The border lands of the empire suffered from the invasions of the Germanic peoples and the Persians, and a pestilence which raged for 15 years (251-265) carried off one half of the inhabitants of the empire. The fortunes of Rome rose somewhat under the following emperors, Claudius (268-270), Aurelian (270-275) who drove the Goths beyond the Danube and overthrew the Palmyran kingdom of Zenobia, Tacitus (275-276), and Probus (276-282) who held the Rhine against the Germanic tribes. Carus (282-283) perished in a campaign against the Persians and was succeeded by Numerianus (283-284) who died in the following year. The army thereupon proclaimed as emperor Valerius Diocletianus, who after the death of Carinus (283-285) became sole master of the empire.

Diocletian abandoned the ancient forms of government and transformed the empire into an absolute monarchy. He separated the civil and military administrations, created a new order of officials and brought the finances into order. The supreme power he vested in the hands of two Augusti assisted by two Cæsars who in turn were to succeed to the office of Augustus. Thus a more efficient administration would be ensured by the practical division of the empire into four parts. Diocletian, however, did not count on personal ambitions which were destined to wreck his plan. In 305 Diocletian resigned his office and compelled his fellow Augustus, Maximianus, to do likewise. They were succeeded by the Cæsars, Constantius Chlorus and Galerius, while new Cæsars were created. Confusion and civil war followed and at one time there were six Augusti in the field. The struggle finally narrowed down to a contest between Licinius and Constantine, a son of Constantius, and after two wars Licinius was overthrown and Constantine became sole ruler of the empire. Constantine the Great (324-337) continued the administrative policy of Diocletian. He built Constantinople as a new capital for the empire and made Christianity the state religion. Of his three sons to whom he left power, Constantinus, Constantius and Constans, the first died in 340 and the last in 350. Constantius ruled with undisputed power from 353 to his death in 361. He was followed by Julian, known as the Apostate, (361-363), who fell against the Persians, and Jovian (363-64). Valentinian I. ruled from

364 to 375. He left the government of the east to his brother Valens and made his son Gratian co-emperor. Gratian ruled till 383 with Valentinian II. as co-emperor. The Goths had now broken into the empire and in 378 they inflicted a terrible defeat upon Valens at Adrianople. In this extreme Gratian conferred the government of the east upon Theodosius (379-395), who by war and diplomacy effected a settlement with the Goths. In 392 Valentinian II. died and Theodosius became sole ruler of the empire. His own death followed in 395, after he had divided the empire between his sons, Honorius, to whom was assigned the West under the guardianship of Stilicho, and Arcadius, who became emperor of the East with Rufinus as his adviser. The influx of Germanic tribes into Italy increased in volume. The tide of invasion was checked for a moment by the generalship of Stilicho (q.v.), but in 410 Rome was sacked by the Goths under Alaric, who, passing into southern Gaul established a kingdom there. Other Germanic hordes wrested Spain from the Roman arms. Honorius died in 423 and was succeeded after a brief interval by Valentinian III. who ruled till 455. The defeat of the Huns under Attila on the Catalaunian Fields in Gaul (451) by Aetius was the last effective assertion of the Roman power. Valentinian III. was murdered in 455 and in the strife for the throne that followed, Valentinian's widow summoned to her aid the Vandals from Africa, who plundered the city of its treasures. For 20 years there came a succession of shadow kings, made and unmade by the all powerful commanders of the German mercenaries, Ricimer, and after him Orestes, who in 475 placed his young son Romulus on the throne. The troops under Odoacer (q.v.) revolted, Orestes was overthrown, the child emperor was retired to private life and in 476 Odoacer assumed for himself the title of king of Italy, thus marking the end of the Roman empire in the West. For the history of the East Roman empire see BYZANTINE EMPIRE.

History of the City of Rome subsequent to 476 A.D.—After the overthrow of the Western Empire and the defeat of Odoacer (see ITALY, History) Rome came under the rule of the Ostrogoths. The city suffered severely in the wars between the Goths and Byzantines, in the course of which the city was taken six times. The depredations of the Byzantine emperors as well as of the Christian authorities, who made use of the materials and ornaments of the ancient edifices in the erection of their churches, were the cause of the destruction of many ornaments of the imperial city; but more destructive still were the feuds that afterward (especially in the 10th century and later) raged in Rome between the leading families. In 1084 a part of the Campus Martius, and most of the city in the south, were devastated by the army of Normans, Greeks, and Saracens which Robert Guiscard led to the relief of Gregory VII., then besieged by Henry IV. of Germany in the Castle of Sant' Angelo. In the 14th century the work of destruction and depopulation was hastened by the struggles which resulted from the attempt of Rienzi (q.v.) to found a republic, and was continued during the period of confusion that ensued after the commencement of the great schism in 1378. A terrible pestilence which raged in the city in 1348, is said to have reduced

the number of inhabitants to less than 20,000. A temporary check was given to the confusion that prevailed in Rome toward the end of the 14th century by Boniface IX., but order was not permanently re-established till Martin V. took up his residence in the city after the schism had been virtually terminated by the Council of Constance. Martin's successor, Eugenius IV. (1431-47), is usually named as the pope under whom the work of restoration in Rome began. In this he was followed by Nicholas V. (1447-55), who began the building of the Vatican, Pius II. (Æneas Sylvius, 1458-64), Paul II. (1464-71), who, however, quarried in the Colosseum for the erection of the Palazzo di Venezia, as did also Paul III. (1534-50), when building the Palazzo Farnese. But the most important period in the architectural history of modern Rome was the end of the 15th and beginning of the 16th centuries, when the labors of Bramante, the two Sangalli, Peruzzi, and Michelangelo were pursued under the patronage of Sixtus IV., Alexander VI., Julius II., and Leo X., and when the works of the great architects were adorned in the interior by artists as great or greater, such as Raphael and Michelangelo himself. In 1527 the city was sacked by an imperial army under the Constable of Bourbon. From this date onward the city began to extend more and more over all parts of the Campus Martius. Much was done in the 16th century, especially by Paul III., Pius IV., Gregory XIII., and Sixtus V., for the embellishment and enlargement of the town, the improvement of the streets, and the restoration of the fortifications. Many remains of antiquity were then rescued from destruction, although many more were sacrificed, particularly under Sixtus, for the sake of modern structures. In the 18th century Benedict XIV., Clement XIV. (founder of the Museo Pio-Clementino), and Pius VI. deserve special mention for their efforts to preserve and beautify Rome. In 1798 Rome was occupied by the French, and deprived of many of its art treasures. At the same time a republic was erected in Rome, but this only lasted for a short time, and after a series of disturbances and changes the pope was again reinstated in his dominions in 1799. (See ITALY.) From 1809 to 1814 Rome was once more under French rule, the States of the Church having in the former year been annexed to the Napoleonic empire. The short-lived Roman Republic of 1848-9 was followed by the restoration of the papal rule in 1850. On 20 Sept. 1870, the Italian troops, after effecting a breach in the Porta Pia, in the northeast of the city, marched in along the Via di Porta Pia (henceforth called Via Venti Settembre). Since then Rome has been in the possession of Italy, and since the 1st of July of the following year, the capital of the kingdom.

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of Recent Discoveries' (1888); Merivale, 'History of the Romans under the Empire' (1890); Mommsen, 'History of Rome' (1894-5); Montesquieu, 'Considérations sur les Causes de la Grandeur et de la Décadence des Romains' (1734); Niebuhr, 'History of Rome' (1859); Peter, 'Geschichte Roms' (1881).

Rome, N. Y., city in Oneida County; on the Mohawk River, the Erie and the Black River canals, and on the New York C. & H. R., the New York, O. & W., and the Rome, W. & O. R.R.'s. The last mentioned now (1904) belongs to the N. Y. C. & H. R. railroad. The city is about 110 miles west by north of Albany and 16 miles northwest of Utica. It is at the head of the Mohawk Valley, on a plateau about 450 feet above Sea-level. The first settlement was made in 1760 by John Roof. The central part of the city is the site of Fort Stanwix (q.v.), erected here in 1758 at a cost of over \$200,000. It was then a place of great importance as it was the defensive point in the "carrying place," or portage, that part of the route between the Atlantic and the Great Lakes, where the journey had to be made by land. Fort Stanwix was a storm centre in the French war and also in the Revolutionary War. Here in July and August, in 1777, there were many sharp engagements, and finally the Tryon County militia under Herkimer defeated the British under St. Leger in the battle at Oriskany. A government arsenal was established here in 1814, but in 1873 was sold for a factory. In 1819 Rome became a village and in 1870 was chartered as a city.

The greater part of the water supply is taken from the Mohawk River, two miles above Rome, at a place called Ridge Mills. The surrounding country is devoted to farming and dairying; but Rome is a manufacturing city. The chief industrial establishments are brass and copper mills, locomotive works, knitting mills, brick works, canneries, breweries, metal bedstead factories, and creameries. The facilities for transportation give Rome considerable commercial advantages. The prominent public buildings are the Rome State Custodial Asylum for Incurable Insane, the Oneida County Home, the municipal buildings, and some of the business blocks. There are 17 churches and two missions. The educational institutions are the Central New York Institution for Deaf Mutes, Saint Peter's Academy (R. C.), opened in 1865, 10 graded public and parish schools, five public kindergartens, four private schools, and three libraries. The libraries are the high school, the Jervis City Library, and the Y. M. C. A. Library. There are two national banks with a combined capital of \$200,000, and two savings banks. In January 1900, the city debt was \$427,564, largely due to the amounts paid for the city sewerage and for the waterworks. This amount has been considerably lessened. The assessed valuation, in 1903, was nearly \$7,300,000. The government is vested in a mayor and a council of 15 members, who hold office three years. Pop. (1900) 15,343; (1910) 20,497.

A. H. WRIGHT,
'Rome Sentinel.'

Rome, Œcumenical Councils of, are six in number, namely, five Lateran Councils, so called as having been held in the Lateran palace; and the Vatican Council, held in the palace of the Vatican. 1. The ninth General Council of the Church, the first Lateran Council, was held in

the reign of Calixtus II. in 1123; it confirmed the concordat of Worms regarding Investiture (q.v.). 2. The second Lateran (10th general) Council, held in 1139 under Innocent II., condemned the Manichean errors of Arnold of Brescia (q.v.). 3. The third Lateran (11th general) Council, under Alexander III. in 1179, condemned the heresies and impieties of the Waldenses and Albigenses. 4. The 12th general Council (4th Lateran) held in 1215 in the pontificate of Innocent III., confirmed the doctrine of transubstantiation and promulgated decrees for the reformation of abuses in the Church and the extirpation of heresies. 5. The 19th General Council (5th Lateran) under Julius II., assembled in 1511, was in session till 1517 when Leo X. was pope; it enacted some laws for the reformation of clerical discipline, and procured from the king of France, Francis I., the revocation of the Pragmatic Sanction (q.v.) which the French clergy had ever regarded as the bulwark of the Gallican Liberties. 6. The Council of the Vatican (20th Œcumenical council), which was opened 8 Dec. 1869 and closed 20 Oct. 1870, under Pius IX., affirmed as the teaching of the Catholic Church the doctrine that the Pope when teaching *ex cathedra* and defining matters of faith or morals is always divinely aided and is infallible.

Rome State Custodial Asylum, an institution for the custody, maintenance and treatment of the custodial class of feeble-minded, located at Rome, N. Y. It was formerly the Oneida County Insane Asylum and Almshouse, but by the acts of the Legislature in 1893 and 1894, the building and grounds were purchased by the state. Among other things, calisthenics, dancing, drilling, kindergarten, sloyd and articulation are taught. Agricultural colonies for the brighter male inmates have also been established.

Feeble-minded are committed to this asylum from all counties in the State, according to the quota assigned each county, which is based on the population of the respective counties, as compared with the capacity of the institution. For their care there are 21 large buildings, beside several small sheds, etc. The average number of inmates is about 700.

Romeo and Juliet, a tragedy by Shakespeare, first published (unauthorized) in 1597. A corrected edition appeared in 1599. The play was written somewhere between 1591 and 1596, and the legend upon which it is founded first appears in a tale printed at Naples in 1476 among the 'Novelle' of Masuccio di Salerno. Luigi da Porta reproduces it in 'La Giulietta' in 1435, and Bandello includes it in his 'Novelle' in 1554. In 1559 a French version of Bandello's 'Novelle' was printed among Pierre Boiastuau's 'Histoires Tragiques.' In 1562 Arthur Brooke printed his English poem 'The Tragical History of Romeus and Juliet,' on which Shakespeare based his drama. In 1562 Boiastuau's French rendering of the tale was translated into English prose by William Paynter in his 'Palace of Pleasure,' which Shakespeare consulted likewise. The theme has often been chosen for operatic purposes. Zingarelli's opera, 'Giulietta e Romeo' appearing in 1796; Bellini's 'I Capuletti ed i Montecchi' in 1830; and Gounod's 'Roméo et Juliette' in 1867. A

dramatic symphony by Berlioz, 'Roméo et Juliette' was composed in 1839.

Römer, ré'mër, or Roemer, Ole, Danish astronomer: b. Aarhus 25 Sept. 1644; d. Copenhagen 19 Sept. 1710. After study at the University of Copenhagen he was in 1671-81 at Paris, where he made observations in the royal observatory and was elected to the Academy. In 1681 he was made professor of mathematics and director of the observatory at Copenhagen, and subsequently became a councillor of state. He is known chiefly as the discoverer of the finite velocity of light, which he determined by observation of the eclipses of the satellites of Jupiter. He found that when Jupiter and the earth were on opposite sides of the sun, the eclipse seemed to occur too late; when on the same side, too early. The extreme deviation from mean time he computed at 11 minutes; it is now known to be approximately 8 minutes 20 seconds, that is, light crosses the space between the earth and the sun (a little less than 93,000,000 miles) in about 8 minutes. (See LIGHT.) Römer invented the transit instrument (1689) and meridian circle (transit and vertical circle combined; 1690). Consult Grant, 'History of Physical Astronomy' (1852).

Romero, rō-mā'rō, Don Matias, Mexican diplomat: b. Oaxaca, Mexico, 24 Feb. 1837; d. Washington, D. C., 30 Feb. 1898. He was graduated from the Academy of Theoretical and Practical Law, Mexico City, in 1855, and admitted to the bar in 1857. In the revolution of that year he supported the government and served as secretary to Melchor Ocampo. In 1859 he was appointed secretary to the Mexican legation at Washington and in 1860-3 was *chargé d'affaires*. He then returned to Mexico where he was commissioned colonel in the army, became chief of staff to General Diaz, and later in the same year resumed his diplomatic career as minister to the United States. He held the portfolio of the treasurer in Juarez's cabinet in 1868-73, was a member of the senate in 1876 and on the election of Diaz to the presidency he resumed his position in the treasury. He was postmaster-general in 1879-80, and in 1882 he was again sent as minister to the United States, where he arranged the boundary question and concluded a reciprocity treaty. He was reappointed in 1884 and continued in the position until his death. He published more than 50 volumes, chiefly of technical reports, among which are: 'Coffee-culture on the Southern Coast of Chiapas' (1875); 'Correspondence of the Mexican Legation at Washington during the French Intervention' (1870-85); 'The State of Oaxaca'; 'Mexico and the United States.'

Romeyn, rō'min, John Brodhead, American Presbyterian clergyman: b. Marbletown, N. Y., 8 Nov. 1777; d. New York 22 Feb. 1825. He was graduated from Columbia in 1795 and was licensed to preach in 1798. He held charges at Rhinebeck, Schenectady, Albany, and New York successively, attained a high reputation as a theologian and was popular as a preacher. He was one of the founders of Princeton Theological Seminary, president of Transylvania University, a trustee of Princeton College and a moderator in the Presbyterian General Assembly. His sermons were collected and published in 1816.

Romilly, rōm'i-lī, Sir Samuel, English statesman and jurist: b. 1 March 1757; d. London 2 Nov. 1818. He entered Gray's Inn to study for the bar, to which he was called in 1783, and gradually rose to distinction in the court of chancery, in which he ultimately took the lead. During the short administration of Fox and Lord Grenville (1806) he was appointed solicitor-general (being member for Queensborough), and knighted. When the Whigs went out of office he remained in Parliament, where he pleaded the necessity of a revision of the criminal code, with a view to the limitation of capital punishment, and a more appropriate regulation of the scale of penalties. To his exertions may be traced the final determination of the executive to the reform and condensation of the various acts in regard to crime, effected under the superintendence of Sir Robert Peel. Consult: 'Memoirs,' written by himself (1840); also 'The Creery Papers' (1904).

Romney, rōm'nī, George, English painter: b. Becksides, near Dalton-in-Furness, Lancashire, 15 Dec. 1734; d. Kendal 15 Nov. 1802. His father was a cabinet-maker, and the boy learned this trade, but he also taught himself drawing and carved wood, and at 19 was apprenticed to a portrait-painter at Kendal named Steele. In 1757 he entered on his own career as portrait-painter, and after a certain amount of local success went up to London (1762), leaving his wife (whom he married in 1756) and his two children in Kendal. The following year he won a prize offered by the Society of Art for a historical painting, by his 'Death of General Wolf,' and rose steadily in popularity until he held a position beside Reynolds and Gainsborough as a portrait-painter. He visited France twice; once in 1764 and again in 1790, and resided in Italy during the years 1773-5. While in Italy he gave much attention to the works of Correggio, and this, along with his study of the nude, greatly influenced his after-work. In 1783 Romney made the acquaintance of Emma Hart, who afterward married Sir William Hamilton, and she became the model from which he painted such well known pictures as 'St. Cecilia,' 'Joan of Arc,' 'A Magdalene,' 'A Bacchante,' and 'Sensibility.' His 'Lady Hamilton as Circe' sold in 1890 for \$20,210; his 'Lady Hamilton as Sensibility' in the same year for \$15,025. Gradually he began to withdraw from portrait-painting, and give more time to historical and imaginative work. In 1786 Alderman Boydell founded his famous Shakespeare gallery, to which Romney contributed a scene from the 'Tempest' and the 'Infant Shakespeare attended by the Passions'; while about this time he painted 'Milton and his Daughters,' and 'Newton making Experiments with the Prism.' In order to find room for these great imaginative pictures he erected a large studio at Hampstead, which he occupied in 1797. But his health at this time began to fail, and in the summer of 1799 he returned to Kendal utterly weakened in body and mind. He had only seen his wife twice since he left her 35 years before, yet she received and nursed him faithfully through his premature senility and dotage until his death.

The art of Romney displays a certain fitfulness of achievement due partly to the instability of his character, and partly to his defective early training. His defects of technique are most

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apparent in his historical and imaginative subjects; it is only when we examine his portraits, and especially his female portraits, that we find that beauty of form and subtle charm of color which place him among the greatest portrait-painters of the 18th century.

Consult: Hagley, 'Life of George Romney' (1809); Gamlin, 'George Romney and His Art'; Gower, 'Romney and Sir Thomas Laurence'; J. Romney, 'Memoirs of the Life and Writings of George Romney' (1830).

Romney (W. Va.), Engagements at. This place was important as an outpost of the Union troops guarding the Baltimore & Ohio Railroad, and also as a base for operations up the valley of the south branch of the Potomac. It was held early in June 1861 by Col. Angus McDonald, with about 500 Virginia troops and two guns. On the night of 12 June Col. Lew Wallace, with 800 men of the 11th Indiana regiment, went by rail from Cumberland to New Creek Station, and marching across the mountains attacked and routed McDonald on the 13th, and on the same day started on his return by the route he had come. Information of Wallace's movement reached Gen. J. E. Johnston, commanding the Confederate forces at Harper's Ferry, on the morning of the 14th, and supposing it to be the advance of Gen. McClellan's column from West Virginia to co-operate with Gen. Patterson, who was threatening to cross the Potomac at Williamsport, Johnston ordered Col. A. P. Hill, with three regiments, to march on Romney and check the movement (see **NEW CREEK**), burned all the bridges on the Potomac from Harper's Ferry to Williamsport, abandoned Harper's Ferry, and fell back to Winchester. On 23 September Lieut.-Col. Cantwell, with detachments of the 4th and 8th Ohio, a company of cavalry, and one gun, marched from New Creek, drove McDonald's forces from Romney on the 24th, and with a loss of three killed and 30 wounded, returned to New Creek, closely followed by McDonald's cavalry. On 25 October Gen. B. F. Kelley, with detachments of Ohio and West Virginia troops and two companies of cavalry, in all about 2,500 men and two guns, started from New Creek for the permanent occupation of Romney. He captured it on the 26th, after a sharp engagement with McDonald's forces, driving them beyond the town on the Winchester road, and capturing all their trains, two guns, 300 stands of arms, and much camp equipage. A supporting column of the 2d Maryland, Col. Johns, marching from the mouth of Patterson's Creek, through Frankfort and Springfield, was met by the 114th Virginia Militia, under Col. A. Monroe, at the bridge over the South Branch, seven miles from Romney, checked, and fell back to Patterson's Creek, with a loss of six or eight killed and wounded. On 28 October Gen. "Stonewall" Jackson was assigned to the command of the Valley District, with headquarters at Winchester, and immediately prepared to clear the valley of Union troops. He called out the militia, and being reinforced by Gen. Loring's division from West Virginia, set out late in December to destroy the Chesapeake and Ohio canal, and the Baltimore & Ohio Railroad, and to recover Romney. To withdraw his attention from the railroad, Col. Dunning, in command at Romney, made a demonstration toward Winchester with 2,000

infantry and cavalry and six guns. He marched on the night of 6 Jan. 1862, and next morning at Blue's Gap, 16 miles from Romney, fell upon 700 Virginia militia, under Col. Monroe, scattered them and captured two guns, several prisoners, and some baggage, without the loss of a man, and returned to Romney. On the same day Jackson left the vicinity of Hancock and marched for Romney. Hearing of his approach, the Union troops retreated from Romney on the 10th toward New Creek. Jackson occupied the town on the 14th, and placed Loring's division there in winter quarters. Loring and his officers complained to the Richmond authorities, and the Confederate secretary of war ordered Jackson to move the division back to Winchester, which was done 31 January, and on 7 February the town was again occupied by Union troops, under Gen. F. W. Lander. Between this time and the close of the war the town changed hands several times, but for the greater part of the time was in Union possession. Consult 'Official Records,' Vols. II. and V.

E. A. CARMAN.

Romola, rŏm'ŏ-la, a novel by George Eliot, first published serially in 'The Cornhill Magazine' from July 1862 to July 1863, and issued in book form in 1864. The scene is laid in Florence at the end of the 15th century, and its great figure is Savonarola. The civic struggle between the Medici and the French domination and the religious struggle between Renaissance paganism and ascetic Christianity form the background of the tale. The story proper follows the fortunes of Tito Melema,—a Greek, charming, brilliant, false,—his marriage with Romola of the Florentine house of Bardi, his moral degradation and death. The incidents are many, the local color is rich, but the emphasis of the book is laid on the character of Tito.

Romulus, rŏm'ŭ-lŭs, mythical founder and first king of Rome. He is said to have been the son of Sylvia, generally, but incorrectly, called Rhea Silvia, daughter of Numitor, king of Alba, and one of the priestesses of Vesta. By the god Mars she became the mother of male twins, whom Amulius, who had usurped the throne of Numitor, ordered to be thrown into the Anio, but the basket containing the two boys, Romulus and Remus, was stranded at the foot of the Palatine Hill. Here a she-wolf, going down to the river to drink, was attracted by their cries, carried them to her cave, and suckled them. Some time afterward chance brought thither Faustulus, the king's herdsman, who took them home and educated them. With him Romulus and Remus spent their youth. When they had grown up Amulius was deprived of his usurped throne by Romulus who reinstated his grandfather Numitor in his dominions. After this the brothers resolved to build a city. Romulus wished to place it on the Palatine, Remus on the Aventine, or on another hill three or four miles down the Tiber. Determining to reach a decision by consulting the augurs, each took his station on his favorite hill; the night passed away, and at the first streak of dawn Remus saw six vultures; but at sunrise, when this news was brought to Romulus, 12 vultures flew by him. Each claimed the augury in his favor; but as their companions decided for Romulus his brother was forced to yield. Romulus,

to outline the boundary of the city, yoked a bullock and a heifer to a plow, marked a deep furrow round the base of the Palatine, and guided by this line began to raise the wall. Remus leaped over the rude rampart in scorn, whereupon the enraged Romulus slew him. According to another tradition Remus fled from the anger of his brother beyond the Alps, and founded Rheims. Romulus was immediately struck with remorse, and could obtain no rest till he appeased his brother's shade by instituting the festival of the Lemuria for the souls of the departed. Thus is Rome said to have been founded in the year 753 (or according to others 752 or 751) B.C. The small number of friends who had followed Romulus were insufficient to people his city. Men enough were gained by making the city a refuge for exiles; but the Roman citizens soon wanted women. Romulus thereupon instituted a religious festival, to which he invited the Sabines with their wives and daughters. In the midst of the festival the unarmed strangers were suddenly attacked, and the Sabine women borne away as captives. The two states thus became engaged in war; but the entreaties of the ravished females, who threw themselves between the contending parties, at length effected a peace, and Rome gained by her union with the Sabines an important addition. According to tradition Romulus ascended to heaven into the company of the gods, after he had completed the work of founding the eternal city; and, until the introduction of Christianity, Rome worshipped its founder in temples expressly dedicated to him.

Ronaldshay, rŭn'ald-shā, **North and South**, two of the Orkney Islands (q.v.), Scotland.

Ronayne, rō-nān', **Maurice**, American Roman Catholic clergyman and author: b. Castlemartyr, Ireland, 2 April 1828; d. Fordham, N. Y., 3 March 1903. He received his education for the priesthood in Ireland and France, and entered the Jesuit Order in 1853. He came to the United States in 1855, was ordained to the priesthood in 1856, taught in St. John's College, Fordham, N. Y., and was for many years professor of history in the college of St. Francis Xavier, New York. In 1898 he returned to the college at Fordham, where he spent the remaining years of his life as spiritual director. His writings upon the labor question may be found in various Roman Catholic periodicals. His most important books are: 'Religion and Science' (1879) and 'God Knowable and Known.'

Ron'cador, one of several Californian drum-fishes of the family *Scianidae*, especially the red *Sciana saturna*, and *Roncador stearnsi*, both food-fishes of some importance.

Roncesvalles, rŏn-thēs-vāl'yēs (French, RONCEVAUX, rŏns-vō), Spain, a valley in Navarre, between Pampeluna and St. Jean de Port, where, according to tradition, the rear of Charlemagne's army was defeated by the Arabs in 778, and the brave Roland killed. The battle forms an essential part in the fabulous cyclūs of Charles the Great or Charlemagne. (See **ROLAND** and **ROMANCE**.) Roncesvalles, the chief place of the valley, 22 miles northeast of Pampeluna, is traversed by the so-called Gates of Roland, leading over the Pyrenees to France; in the church fabulous antiquities bearing the name of Roland

are shown. The French under Moncey defeated the Spaniards here in 1794, and here Soult took up a strong position in 1813, from which he was dislodged by Wellington.

Ron'co, a West Indian name for various drumfish of the genus *Hamulon*, popular among fishermen and in the market, especially *H. bonariense* (ronco prieto) and *H. parra* (ronco blanco) or sailor's choice.

Rondeau, rŏn'dō, or **Rondo**, originally a short lyric of 13 lines divided into three unequal strophes; the two or three first words form the burden, and are repeated after the 8th and 13th line. The term is now chiefly applied to a musical composition, vocal or instrumental, generally consisting of three strains, the first of which closes in the original key, while each of the others is so constructed in point of modulation as to reconduct the ear in an easy and natural manner to the first strain. The rondeau takes its name from the circumstance of the melody going round after both the second and third strain to the first strain, with which it is finally closed. While it frequently forms the last movement of a sonata or a symphony, it is quite as common as a separate composition.

Ronge, Johannes, yŏ-hān'nēs rŏng'é, German Anti-Catholic religious leader: b. Bischofswalde, Silesia, 16 Oct. 1813; d. Vienna 26 Oct. 1887. He studied theology at the University of Breslau 1837-9, was ordained to the priesthood in 1840, and in 1841 became chaplain at Grottkau. Having manifested an opposition to the discipline of the church, he was suspended in 1843. On 1 Oct. 1844, he published a letter against the exhibition of the "holy coat" at Treves, which was soon followed by the organization of the so-called German Catholic congregations. (See **GERMAN CATHOLICS**.) He published in succession a number of pamphlets, in which he called on the Roman Catholic laity and the lower clergy to leave the communion of that church. These were generally understood to be written from the standpoint of deism; and in subsequent years Ronge pronounced himself more and more unreservedly in favor of deistic doctrines. He took part with the radicals in 1848, and was obliged to flee to London, where he signed in 1851, with Ruge, Struve, Kinkel, and others, a democratic manifesto to the German people, and where he became the leader of a free congregation. In consequence of the amnesty granted by the Prussian government, he in 1861 again made his appearance in Breslau. He founded a reform association at Frankfurt-on-the-Main in 1863, and from 1873 resided at Darmstadt. Consult the article 'Deutschkatholiken' in Wetzzer und Welte's 'Kirchenlexikon.'

Ronsard, Pierre de, pē-ār dē rŏn-sār, French poet: b. Chateau de la Poissonnière, Vendômois, 11 Sept. 1524; d. St. Cosme near Tours, 27 Dec. 1585. He entered as page the service of the dauphin, and then of the Duc d'Orléans, 2d son of the king. In 1538 he accompanied James V. of Scotland and his bride Marie de Lorraine back to their kingdom, and remained at the Scottish court three years. He also spent six months at the English court, and was then employed in a diplomatic capacity in Germany, Piedmont, Flanders, and Scotland.

ROOD — ROOF

On his return to France he devoted himself with great eagerness to the study of literature. With a group of followers, self-styled the "Pleiade," he cast away the literary traditions and ideals of mediæval France, and sought inspiration from the Latin and Greek classics. The result was transformatory, and Ronsard's influence on the progress of French letters was thus very great. In the Floral Games at Toulouse he triumphed over his competitors, and received a silver statue of Minerva, which he presented to Henry II. He was greatly esteemed by that prince, and by his successors, Francis II. and Charles IX.; obtained the abbey of Bellozane, and was also prior of St. Cosme. His writings, consisting of sonnets, madrigals, eclogues, lyric pieces, elegies, and satires, and a fragment of an epic poem, 'La Franciade,' were read with almost incredible admiration by his contemporaries, and brought him valuable presents from Queen Elizabeth of England and the imprisoned Queen of Scots. Many of his sonnets and odes possess considerable merit, but his style is marred by affectation, and his pages are filled with freshly imported words from the classic languages. There are editions by Blanchemain (1856-67) and Marty-Laveaux (1887 et seq.).

Rood, Ogden Nicholas, American physicist: b. Danbury, Conn., 3 Feb. 1831; d. New York 12 Nov. 1902. He was graduated from Princeton in 1852 and afterward studied at Yale and at the universities of Munich and Berlin. He was appointed to the chair of physics and chemistry at the University of Troy in 1858, and in 1863 accepted the chair of physics at Columbia where he remained until his death. In his researches and experimental work he showed great originality and skill, his specialties being in the fields of mechanics, optics, acoustics, and electricity. His original experiments included the application of stereoscopic photography to the microscope, the quantitative analysis in color contrast, the measurement of the duration of flashes of lightning, and he was the first to describe a photometric method that is independent of color. He was a leading member of the prominent scientific societies, author of nearly 100 monographs and also wrote: 'Modern Chromatics' (1881); 'The Voice and the Ear'; etc.

Rood, a cross. The term is more particularly applied to the large cross erected in Roman Catholic churches over the entrance of the chapel or choir; this is often of a very large size, says the 'Glossary of Architecture,' and when complete is like other crucifixes, accompanied by the figures of Saint John and the Blessed Virgin, placed one on each side of the foot of the cross; but these are more often omitted. The rood loft was the gallery in which the cross was set to view, and the rood-arch was the arch between the nave and the chancel, that is, the arch over the rood-loft. Rood-lofts became common in England in the 14th century, were ordered taken down by the government in the 15th and 16th centuries, and temporarily were restored under Queen Mary. See the Irish Constitution of 1635, p. 110.

Rood. See WEIGHTS AND MEASURES.

Rood-screen, a screen of wood, stone, or wrought iron, separating the western end of the ritual choir from the nave in many churches, and forming a support for the rood, a cross or cru-

cifix, placed in the centre of the rood-beam. Sometimes the rood-screen was double with vaulting between and a rood-loft over it, as at Southwell Cathedral. It was frequently ornamented with niches in which were placed statues, as at York Minster and Rochester Cathedral.

Roof, the covering of a building by which the interior secures protection. In ordinary acceptance the term includes the covering and the supporting framework, though in carpentry the term is applied only to the framework. Roofs are broadly distinguished as flat or sloping. The former were used almost exclusively among ancient peoples and are at present employed largely in Eastern countries where the roof is

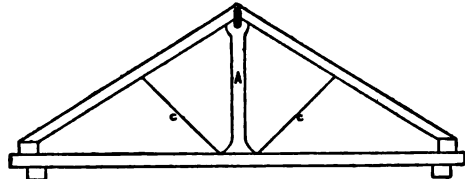


FIG. 1.

devoted to some extent to domestic purposes. The sloping roof, being to a great extent an ornamental consideration, has given way to the flat roof in modern business buildings, where economy of construction prevails. Flat roofs are usually covered with tar, metal, asphalt or gravel. The framework of the roof has, until the modern application of iron to this use, been almost exclusively of timber; and the end desired has been to arrange the timbers in such relations as to secure the greatest strength and stiffness consistent with the minimum of weight; also to avoid lateral strain or thrust upon the walls. The form chosen has been that of two or more inclined planes for the slopes of the roof over the enclosed space. Two inclined planes are formed by a series of sloping rafters having the lower ends tied together to prevent spreading. The upper ends forming the angle of the roof and connected by the ridge-piece. The method of tying the rafters is by a horizontal beam laid across the span, receiving at each end the foot of one of the rafters, the two being securely mortised. This is called a tie-beam. When the roof is of wide span it becomes necessary to secure the tie-beam against settling in the middle, and this is done by joining the centre of the tie-beam and the ridge angle of the rafters by a king-post (A in Fig. 1).

Sometimes two vertical beams are suspended from the rafters to the tie-beam, and these are called queen-posts (BB in Fig. 2).

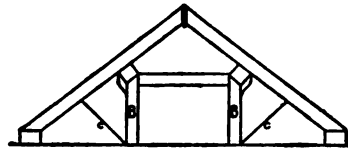


FIG. 2.

Braces or struts (c) may be carried from the foot of the suspended posts to the rafters to afford additional stiffness to the frame. Further support is given to the rafters in roofs of long span by one or a series of transverse

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longitudinal beams called purlins. Early Christian basilicas, of which San Miniato in Florence is typical, had roofs of the character just described. When the period of Gothic architecture was reached the king-post and tie-beam was carved and molded, in cases where wooden roofs were used instead of stone vaulting. Open timber roofs were used in England more than on the Continent for churches and halls. The finest example is that of Westminster Hall (Fig. 3) completed in 1399 and having a span of 68 feet.

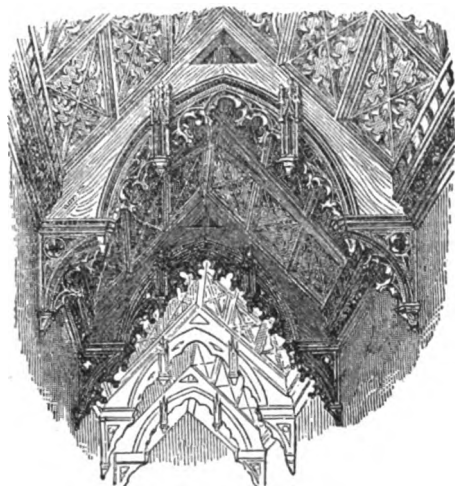


FIG. 3.

In this example the central part of the tie-beam is cut away, and the great rigidity of the framework prevents any inordinate thrust upon the walls.

The inclination or pitch of the roof seems to be regulated by taste, after the general law is observed that countries of moist climate require a sloping roof to carry off the rain and snow. The slope of a Greek pediment, marking that of the roof, varied from 15° to $16\frac{1}{2}^{\circ}$; Roman roofs, the roofs of Romanesque buildings, and also those of the Renaissance era, generally carried an inclination increased one quarter to that of Greek buildings. The Gothic pitch sometimes reached to 50° or 60° . But since the period of the prevalence of one particular style, great latitude has been observed, Germany and the Netherlands favoring a steep roof, and France retaining a moderately steep inclination even in her Renaissance structures; but England has tended toward the lowering of the pitch.

The commonest form is the gable roof where each end terminates in a gable. Modifications of this are the curb-roof in which the slope is broken; further distinguished as the gambrel roof where only two opposite sides are sloping; the French roof where the slope beneath the curb approaches almost to verticality and that above is nearly flat or with a slightly visible slope; the Mansard roof, named after its designer, Mansard, where the slope beneath the curb is pierced by dormer windows. The hipped roof is one having a double pitch and no gables, and the ridge shorter than the parallel wall plates. The pyramidal roof is one where the ridge is so short as to approach a point. Various

modifications of these general forms are known by a variety of names.

The recent use of iron for roof-frames has become very general, especially where wide spans are required as in the case of railway train sheds. The general principles of construction employed in wooden frames are utilized in iron ridge roofs; but for oval or conical roofs, the iron trusses require a consideration of the principles governing those of bridge trusses. See BRIDGES.

The covering of sloping roofs is of various material, such as thin slabs of stone, thatch, tiles, slate, metal, shingles and cement.

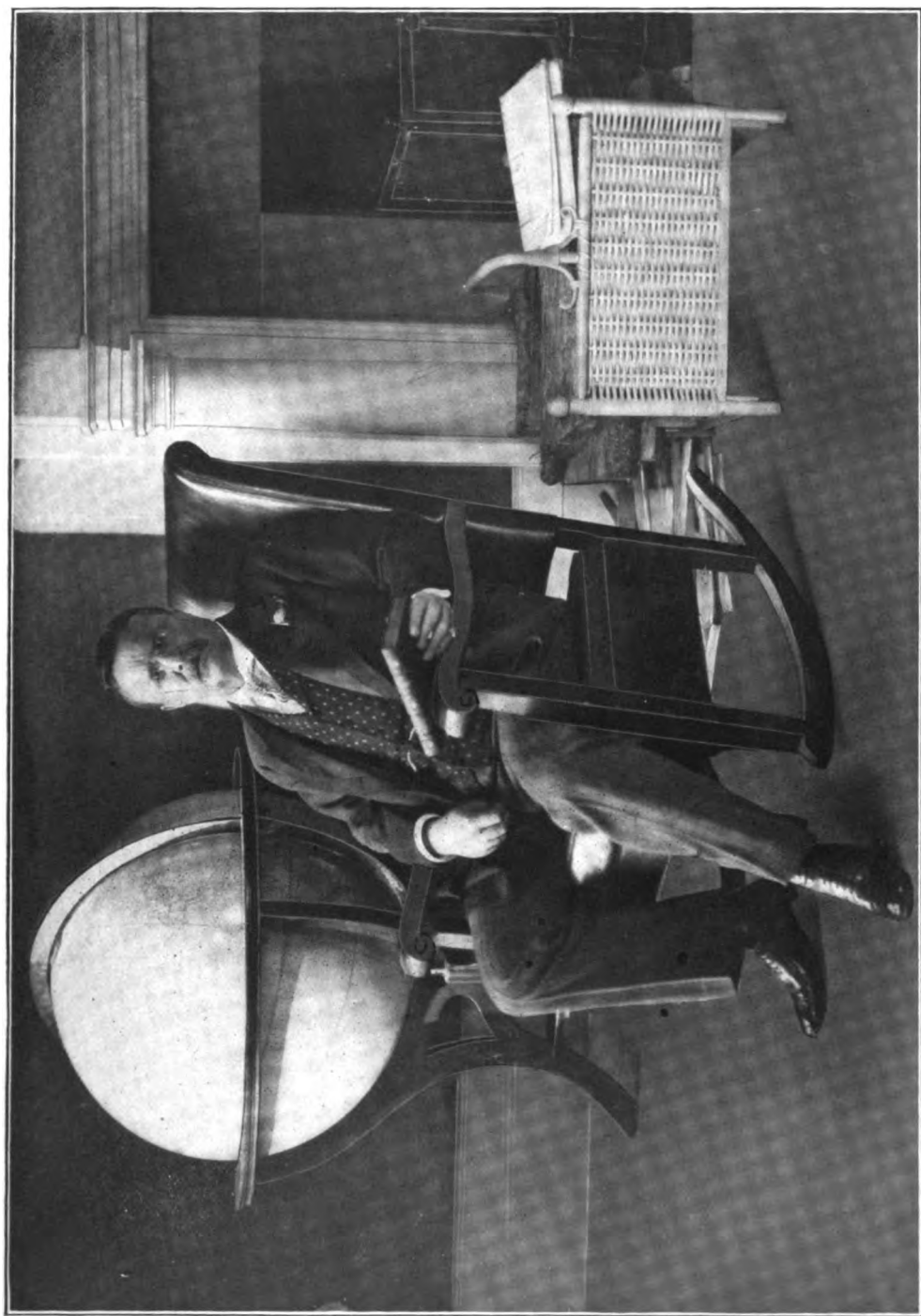
Roofing Tiles. See TILES.

Rook, a European crow (*Corvus frugilegus*), having the base of the bill, forehead and upper part of the throat naked. The rook possesses a voice much less harsh than that of the crow. Rooks are gregarious in habits, and nest in great communities or rookeries, thus differing from other species of the family. The nests, which are placed in tree tops, are built or repaired early in March, and the young are hatched in April. The food consists chiefly of grubs, although grain appears to form part of the dietary. In Great Britain the rook is a permanent resident or partial migrant, but in other parts of Europe these birds appear to be more or less strictly migratory. The same species is found in Asia, where related species having the facial feathers only partially deciduous also occur.

Rooke, rûk, **SIR GEORGE**, English admiral: b. 1650; d. 24 Jan. 1708-9. At an early age he entered the royal navy, and in 1694 became one of the lords commissioners of the admiralty and admiral. He distinguished himself in the fight against the French and Spanish fleets in Vigo Bay (1702), and at the capture of Gibraltar in July 1704. On 9 Aug. 1704 he fell in with a French fleet of much superior force, under the Comte de Toulouse, off Malaga, and an engagement, which lasted nearly the whole day, ensued. Victory remained with the English, though none of the French ships were captured. The news of the Malaga victory reached England during the celebration over Blenheim, and Rooke's name was put forward for honors along with Marlborough's; but being a Tory he suffered from the jealousies of the Whigs, the dominant power. His command was taken away from him and he retired in disgust to his family seat in Kent.

Rookwood Pottery. See POTTERY.

Roon, rôn, **ALBRECHT THEODOR EMIL VON**, Prussian soldier: b. Pleushagen 30 April 1803; d. Berlin 23 Feb. 1879. He entered the army in 1821; was attached to the Topographical Bureau in Berlin, 1833-5; became captain in 1836, and major in 1842; in 1848 became chief of staff of the 8th army corps at Coblenz, took part in the campaign at Baden of that year; and was promoted lieutenant-general in 1859. In the latter year he was appointed a member of a commission on the reorganization of the army. He had given special attention to this subject for many years, but his proposals which were in effect an extension with modifications of Scharnhorst's system, embracing a universal three years' service and a reserve were carried only after long opposition. The Austrian war of 1866 demonstrated that value of his sys-



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TWENTY-SIXTH PRESIDENT OF THE UNITED STATES.**

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tem. He attended the German emperor throughout the Franco-Prussian war, and was created a count in 1871. The ministry of war which he had held since 1859 he resigned in 1871 together with the ministry of marine, held since 1861. In 1872 he succeeded Bismarck as president of the Prussian cabinet and was made field-marshal shortly after; but soon resigned. He was the author of several works on geography published between 1832 and 1839.

Roosevelt, rō'zē-vēlt, Nicholas J., American inventor: b. New York 27 Dec. 1767; d. Skaneateles, N. Y., 30 July 1854. He engaged in manufacturing and inventing in New York and was connected with Robert R. Livingston and John Stevens in experimental boat-building. In 1798 he conceived the idea of a vertical wheel, a suggestion which made steam navigation a success. The first experiment was made in a boat launched in 1802 and propelled by the vertical wheels. In 1809 he was associated with Fulton in the introduction of steamboats into western waters and in 1811 built and launched the New Orleans with which he made a pioneer trip down the Ohio and Mississippi rivers in 14 days. He obtained letters patent from the United States government in 1814 protecting his invention, but was denied protection by the New Jersey legislature. Fulton never claimed the invention as his own, but Roosevelt's title to it has never been legally proved.

Roo'sa, Daniel Bennett Saint John, American ophthalmologist: b. Bethel, N. Y., 4 April 1838. He was graduated from the University of New York in 1860, served as assistant surgeon in 1861 and became resident surgeon at the New York Hospital in 1862. He studied in Europe in 1863 and in the following year began practice in New York. From 1863-82 he was professor of diseases of the eye and ear at the University of New York, occupied the same chair at the University of Vermont in 1875-80.

Roos, Johann Heinrich, German painter: b. Otterberg, in the Palatinate, 27 Oct. 1631; d. Frankfurt-on-Main 3 Oct. 1685. He came to Amsterdam and applied himself to landscape and animal painting. After a visit to Italy he settled finally at Frankfurt. Most of his landscapes are in the conventional Italian style.

Roosevelt, Robert Barnwell, American author and politician: b. New York 7 Aug. 1829; d. Sayville, L. I., 14 June 1906. He was admitted to the bar and practised law in New York until 1871, when he was elected to Congress. In 1888 he was appointed minister to the Netherlands and served two years. His most important public service, however, was in the establishment of the United States Fish Commission, of which measure he was the originator and promoter while in Congress.

Roosevelt, Theodore, American politician and author, 26th President of the United States: b. New York 27 Oct. 1858. He was educated privately and at Harvard, from which he was graduated in 1880; then for a year traveled in Europe, which he later at intervals revisited; and in 1881 published his first book, 'The Naval War of 1812,' characterized, like his subsequent works, by creditable research, general accuracy, and vigorous statement. He came into politics as a champion of civil-service principles. In the autumn of 1881 he was elected to the State assembly of New York from the 21st district, and he served in that body continuously until

1884. He introduced into the assembly the first civil-service bill, passed in 1883. In 1884 he was chairman of the New York delegation to the national Republican convention. He was nominated in 1886 as an independent candidate for the New York mayoralty, but, though he received Republican endorsement, was defeated by Abram S. Hewitt (q.v.), candidate of the United Democracy, who was elected by about 22,000 plurality. In May 1889 he was made by President Harrison a member of the United States civil-service commission, in which post he continued until May 1895. During this six years' incumbency he strictly endeavored to apply the test of merit to all executive positions, with the result that the commission assumed a position of importance it has never since lost, and civil-service law gained a new vitality. At the beginning of his term of service, 14,000, at its close, 40,000, employees held their positions under the rules of the civil-service. From the civil-service commission he resigned to become president of the board of New York police commissioners during the administration of Mayor Strong. At once he undertook the task of thorough reorganization. Among the principles insisted on by him was an impartial application of the civil-service idea to appointments to the police force and promotions in it. By his rigorous enforcement of laws and ordinances he gave unwonted effectiveness to the office. This post he relinquished in 1897 to become assistant-secretary of the navy to Secretary John D. Long (q.v.), in the first administration of President McKinley. Quickly acquiring the extensive detailed knowledge necessary to his post, he began to urge that preparation of the navy for warfare which contributed so signally to the triumph of American arms in the Spanish-American war. He called for two appropriations of respectively \$800,000 and \$500,000, for ammunition for naval target practice; and though this was at the time deemed extravagant, it was later amply justified by the skill of American gunners as shown at Manila and Santiago. On 6 May 1898 he resigned his assistant-secretaryship to enter the army. His experience in 1884-8 in the 8th regiment N. Y. N. G., in which he had for a time served as captain, furnished some basis for his military career. He joined Leonard Wood (q.v.), captain and surgeon, U. S. A. (now major-general, U. S. A.), in recruiting the 1st United States volunteer cavalry, of which he became lieutenant-colonel, with Wood as colonel. Notwithstanding he was second in command, his regiment, composed to a large extent of cowboys and western hunters, was popularly known as "Roosevelt's Rough Riders." On 1 July 1898 he led the victorious charge of the "Rough Riders" and the 9th cavalry up San Juan hill, on 11 July was promoted colonel and in September was mustered out. On 27 September he was nominated as Republican candidate for the governorship of New York obtaining 753 ballots to 218 for Governor F. S. Black (q.v.). He entered on an active campaign, and was elected by a plurality of 18,079 over his Democratic opponent, Judge Augustus Van Wyck (q.v.). He at first declined to sanction the use of his name in connection with the vice-presidency in McKinley's second campaign, but ultimately yielded, and was nominated by acclamation at the national Republican convention at Philadelphia 21 June 1900. He immediately set out on an aggressive speaking tour, extend-

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ing to the Far West. The assassination of President McKinley placed him in the Presidential chair. On 14 Sept. 1901 the oath of office was administered by United States District Judge John R. Hazel. Upon his accession he announced that he would unbrokenly continue the policy of McKinley, whose cabinet he retained. In November 1904 he was elected for the full term by a plurality of over 2,000,000 votes, the largest plurality ever given any Presidential candidate. Almost immediately after the expiration of his second term of office as President of the United States (23 March 1909), Mr. Roosevelt, with a large party and ample equipments, sailed for the wilds of Africa to hunt the beasts of the Jungle and otherwise to divert himself. Numerous specimens of game and fauna were shipped to the Smithsonian Institution, which outfitted the expedition.

Returning to civilization in the spring of 1910, Roosevelt passed through Egypt, Italy, France, Belgium, Austria, Germany, Holland, Denmark, Norway, and Sweden—every large country of Europe save Russia—being everywhere received with honor. He lectured to audiences in Egypt, Germany, France, England, and Norway, where he was awarded the Nobel Peace Prize on account of his share in promoting peace negotiations between Russia and Japan some years ago. Before he had reached England in his homeward trip, President Taft appointed Mr. Roosevelt envoy extraordinary to represent the United States at the funeral of Edward VII. In London he was given the freedom of the city, and there addressed the Englishmen on their Egyptian policy—an address which aroused considerable comment, as did his earlier lecture to the students at Egypt. In France he discussed his favorite race-suicide views, and in Berlin lectured on "Biological Analogies in History."

Roosevelt and his party returned to America 18 June 1910 and was enthusiastically greeted by the citizens of New York. For the events of his administration see *UNITED STATES, History*. He has written: 'Hunting Trips of a Ranchman' (1883); a 'Life of T. H. Benton' (1886); a 'Life of Gouverneur Morris' (1887); 'Ranch Life and the Hunting Trail' (1888); a 'History of the City of New York' (1890); 'Essays on Practical Politics' (1892); 'The Wilderness Hunter' (1893); 'The Winning of the West' (1889-96); 'American Ideals' (1897); 'The Rough Riders' (1899); a 'Life of Oliver Cromwell' (1900); 'The Strenuous Life' (1900); 'California Addresses' (1903); 'Maxims of Theodore Roosevelt' (1903); 'Addresses and Presidential Messages' (1904). His works appeared in 8 vols. in 1902. He wrote also in 'Hero-Tales from American History' (1895; with H. C. Lodge); and 'The Deer Family' (1902; with several others). The best of his books is 'The Winning of the West,' the narrative of the conquest of United States territory west of the Alleghanies, which takes good rank among authoritative works on United States history. Consult: Clemens, 'Theodore Roosevelt, the American' (1901); Leupp, 'Roosevelt, the Man' (1904); Baker 'A Character Sketch' (McClure's, vol. 12, 1898); Bigelow, 'President Roosevelt' ('Contemporary Review,' vol. 80, 1901); Rod, 'Le Président Roosevelt d'après son Œuvre Littéraire' ('Correspondant,' vol. 205, 1901); 'North Am. Rev.,' 'President

Roosevelt's First Year in Office' (vol. 175, 1902); Guerlac, 'M. Roosevelt, Orateur' (Révue Politique et Littéraire,' ser. 4, vol. 29, 1903); Brooks, 'President Roosevelt' ('Fortnightly Review,' vol. 81, 1904); Riis, 'Theodore Roosevelt, the Citizen' (1904).

Roosevelt Dam, the greatest engineering work in connection with the Salt River irrigation project in Arizona, which ranks first among the works of the United States reclamation service, was completed in 1910.

This wonderful structure of sandstone and cement, costing nearly \$9,000,000, rises 284 feet above Salt River. It is 1,080 feet long on top and 170 feet thick at the base. Its foundation covers one acre of ground. Placed by the side of a twenty-story building, it would rise ten feet above it, while its length on top would be more than two city blocks. Across its top is a roadway twenty feet wide. The reservoir created by the Roosevelt dam is the largest artificial body of water in the world. Its capacity is sixty-one billion cubic feet, and if its water were spread over the State of Delaware it would cover the entire surface of the State a foot in depth.

Root, root or rüt, Elihu, American lawyer and statesman: b. Clinton, N. Y., 15 Feb. 1845. He was graduated from Hamilton College in 1864, and from the New York University Law School in 1867. In the latter year he was admitted to the bar and entered upon the practice of his profession in New York. In 1883 he was appointed United States District Attorney for the southern district of New York; in 1894 was a delegate-at-large to the New York State Constitutional Convention, and was chairman of the judiciary committee. He was appointed Secretary of War by President McKinley in 1899 and reappointed in 1901. He found the work of his department in disorder with constant rivalry among its various bureaus, but by strict discipline, adherence to civil-service rules, and establishing a system of promotion for merit, he soon brought order into the administrative departments, and turned his attention to the organization of the army. In this field he brought about a number of improvements, chief among which are the assimilation of the militia with the regular army and the creation of the General Staff. He also had charge of the military administration of Cuba and the Philippines; and while he was severely criticised for not trying to prevent cruelties in the conquest of the Philippines, he must also be given credit for the policy of the army in enforcing sanitary measures, and preparing for independent government in Cuba; and for the restoration of order and preparation for civil government and the work of the Philippine Commission in the Philippines. In January 1904 he retired from the secretaryship to resume the practice of law. On 19 July 1905 he was appointed Secretary of State. In 1909 he was elected United States Senator from New York.

Root, George Frederick, American musician and song-writer: b. Sheffield, Mass., 30 Aug. 1820; d. Bailey's Island, Maine, 6 Aug. 1895. He removed to New York where he taught in 1844-50, studied in Paris for a time in 1850, and in 1859 went to Chicago where he became a member of the music-publishing firm of Root and Cady. He was the originator of normal musical institutes and did much to im-

prove the standard of music in this country, founding a school of distinctively American music. His song 'The Battle-Cry of Freedom' (1861) gained immediate popularity and at one time 14 printing-presses were engaged in printing it. 'Tramp, Tramp, Tramp, the Boys are Marching' (1864), though written so nearly at the close of the war, nevertheless gained a wide sale. In a catalogue of 114 war songs 36 were from his pen. Among his songs are; 'Hazel Dell' (1853); 'Rosalie, the Prairie Flower' (1855); 'Just Before the Battle, Mother' (1863); 'Old Potomac Shore'; etc. He also wrote the quartet 'There's Music in the Air' and the cantatas 'The Flower Queen' (1852) and 'The Haymakers' (1857).

Root, that part of a plant which, normally, penetrates the soil, absorbs water and chemicals in solution, for nutritive purposes, forces it through the plant, and also acts as an anchor and support. Roots, however, may also, in modified forms, draw nutriment from other vegetation, or from the air, and may even serve as support and aid to climbing-plants. Low forms of vegetation, and certain submerged aquatics able to absorb water through most of their tissues, have no roots, or only enough to act as anchors.

The primary form of root is that which, starting from the germinating seed, secures it to the ground, and strikes downward into the soil, sending off horizontal branches which in turn branch, until the ground occupied by the fibrous reticulation is thoroughly exhausted of food. In many cases, however, this single central tap-root, so-called, is missing, and numerous horizontal and lateral roots take its place. The growth of the root-system is commensurate with that of the plant above ground. In epiphytes, the roots either adhere to the site of the plant, to hold it in place, or depend freely in the air, drawing nourishment therefrom.

Plants are called annuals, biennials or perennials, according to the length of time the root lives, but the differences are not always absolute, and are often changed by cultivation. Biennials and perennials, especially the former, are apt to have thickened, tuber-like roots, in which nourishment is stored during the growing periods, to be drawn upon when the plant flowers, as in beets and carrots.

Each root is a naked organ, incapable of bearing leaves, which has a blunt apex shielded by a root-"cap" more or less distinct, of old and firm cells. The growing cells of the root lie directly behind this cap, and still further back is a zone of delicate tubular root-hairs, which are devoted to the absorption of liquid foods from the soil, and are constantly dying off and being renewed on the side next the root-cap. The growing tip with cap and root-hairs, continually pushes forward into the soil, while the older portions become inactive so far as absorption is concerned, thicken, envelop themselves in cork, and increase their means of conducting water from the region of the root-hairs to the rest of the plant.

Roots may be produced from stem-nodes, branches, or even leaves (as in begonia), and are then called adventitious. A familiar example of this is found in the aerial roots of banyan and mangrove, which start from the branches

and eventually penetrate the ground, and which not only assist in feeding the trees, but also help to support their gigantic heads. Vines, such as the poison-ivy, have masses of aerial rootlets springing from the stem and fastening it firmly to its support.

The haustoria of certain parasitic plants are a form of reduced roots, and are special organs of absorption which "arise from the internal tissues of the parasite, and possess, in a marked degree, the capability of penetrating to a considerable depth into the body of the host plant by means of solvent ferments and the pressure resulting from their own growth." Once there, they draw sustenance from their host, and often dispense with assimilative organs of their own.

Other parasites have disk-like haustoria upon their root-systems, which fasten upon the roots of other plants, and, although appearing above ground like self-supporting herbs with green foliage, vigorously assimilative, these plants do not reach full development without this clandestine connection. The young roots of saprophytes, or plants living upon the decaying remains of vegetation, seem to require the co-operation of fungi in obtaining food.

The connection of bacteria and leguminous plants is becoming well known. The bacteria penetrate through the root-hairs of the *Leguminosæ*, into the cortex of the root and there raise tubercular growths while living on the carbohydrates furnished by the host. But these bacteria, capable of fixing free nitrogen, furnish the host plant with a steady supply of nitrogenous food. The tubercles are most numerous on legumes growing in poor soil, and by plowing the legumes under the ground they decay, returning the nitrogen to the soil in a form available for the next crop. This process is called green manuring, and is a good treatment for exhausted, non-nitrogenous soils.

Root, in philology. See SCIENCE OF LANGUAGE.

Root and Branch Men, in British politics, a party in the House of Commons and out of it who supported a petition signed by 15,000 London citizens, praying that episcopacy might be destroyed "root and branch." Nathaniel Fiennes, Sir Harry Vane, and Hampden were of the party. A bill to give effect to the petition was read a first and second time in 1641, but was ultimately dropped.

Root-worm. See GRAPE INSECT-PESTS.

Rope. See CORDAGE.

Ropes, Arthur Reed ("ADRIAN ROSS"), English dramatist and poet: b. Lewisham, Kent, 23 Dec. 1859. He was educated at Cambridge. Among his numerous dramatic productions are: 'Faddimer' (1889); 'In Town' (1892); 'Gaiety: a Greek Slave' (1898); 'San Toy' (1899); 'The Messenger Boy' (1900); 'Gaiety: a Country Girl' (1902). He has also published: 'Poems' (1884); 'Short History of Europe' (1889); 'On Peter's Island' with Mary E. Ropes (1901); etc.

Ropes, John Codman, American military historian: b. Saint Petersburg, Russia, 28 April 1836; d. Boston, Mass., 28 Oct. 1899. He was graduated from Harvard in 1857, and from his admission to the bar in 1861 until 1870, practised law in Boston, but devoted the remainder of his

life to historical writing. As the founder of the Military Historical Society of Massachusetts he started the movement for the collection of historical data relating to the Civil War by the United States Government. He spent much time also in the collection of material bearing upon the life of Napoleon. His published books are: 'The Army Under Pope' (1881); 'The First Napoleon' (1885); 'The Campaign of Waterloo' (1893-4); and 'The Story of the Civil War' (1894-9).

Rops, rôps, **Félicien**, Belgian artist: b. Namur 1833; d. 1898. His illustrations for the 'Crocodile,' a journal published at Brussels, appeared for the first time in 1855 and established his reputation as an artist of original genius. But his main employment from that date was book illustration, and many novels of the day have been published with his brilliant pictures, which reflect the cynical spirit of some modern literature with great imaginative power. Many of his drawings are, however, too sheerly naked and unreserved to be pleasing. But his etchings are almost unique in power of execution, especially the series known as 'Sataniques' which while they belong to decadent art are masterpieces of technique. He founded the International Society of Etchers at Brussels and has had a great influence on modern schools of art in Europe. Consult Ramiro, 'Catalogue de l'Œuvre Gravé de Félicien Rops' (1887).

Roque, rôk. Croquet and roque are two varieties of the same game. Croquet is played upon a grass lawn on which the boundaries of a rectangular court are indicated by a chalk line, or by a slight ridge. Roque is played on a specially prepared earth court, with the corners cut off diagonally, the borders curved upward and bounded by india-rubber cushions. In each game the object of each player is to drive his playing ball, by means of a mallet, through a series of iron arches, each in its proper order, and from the proper side, and to strike a peg driven into the ground for that purpose, in the fewest number of "turns" at play. After the first stroke a player may continue, if he has by that stroke either run through the proper hoop or hit another ball with his. In the former case he may try at another hoop, in the latter he must take his own ball to that which he hit with it, and, after placing them side by side, hit his own ball in such a manner that the impact of the blow will move the two. After that he may attempt to run through the next arch, or to hit some other ball with his. Should he fail in any shot he loses his "turn," and his opponent takes up the play.

In croquet the size of the court has varied a good deal, with a tendency to become smaller; 80 feet long by 45 feet wide is a usual measurement, but that depends upon the number of hoops or arches used, which may vary from six to ten; and upon their position with regard to each other. The preferable arrangement is that known as the "Championship" or "Six hoop" plan. The croquet balls are three and five eighths inches in diameter, and weigh fourteen and a half ounces each. The mallets vary from two feet nine inches to three feet in length. The width of the arch of the hoops is three and three quarter inches. Any number of couples of players may play, up to four.

Roque is a much more scientific variety of the game. The court is 72 feet long and 32 feet wide, rectangular, with each corner, for eight feet, cut off diagonally. The surface is well rolled dirt sprinkled with sand. It is surrounded with rubber cushions, so that caroms can be made off the balls the same as they are in billiards. All the arches, of which there are eight, are three and a half inches in diameter. In the centre of the court is a tunnel or cage the arch of which is three and one eighth inches, and it is 18 inches in length. The balls are of hard rubber and are three and a quarter inches in diameter. The mallets' heads are seven and a half inches long, by two and a quarter to two and a half inches in diameter, with a handle from 8 to 15 inches long. Only two players play against each other, each playing two balls.

Both games have elaborate rules which must be studied carefully to obtain a full appreciation of either game. Croquet is the descendant of the old game of "Pall Mall," popular in England up to 1700; but that game died completely out of knowledge, except in a remote corner of Ireland, from whence it emerged as croquet in the middle of the 19th century. It became a very popular game in Great Britain, from whence it passed to America and became equally popular. In both countries it suffered a partial eclipse on the introduction of lawn tennis. It is played in the west on grass as croquet and in the east on the courts above described as roque. For croquet rules, etc., consult 'The Complete Croquet Player' (1896); for roque consult Spalding, 'Athletic Library' (1893).

Roquefort, rôk-fôr, France, a village in the department of Aveyron in the vicinity of which large quantities of the well known variety of cheese of the same name is made from ewe milk.

Roqueplan, Joseph Etienne Camille, zhô-zêf â-tê-ên kâ-mêl rôk-plân, French painter: b. Mallemort, Bouches-du-Rhône, France, 1802; d. 1855. He studied at Paris under Gros and Pujol. His two pictures exhibited at the Salon of 1827 and illustrative of Sir Walter Scott's writings won him a place among the leaders of modern French painting. His most remarkable works include 'The Amateur Antiquary'; and 'The Well near the Tall Fig-Tree.' He was equally successful in genre and landscape, and his faithful transcripts of Pyrenean scenery are among the most delightful of modern French pictures.

Roquette, rô-kê't, **Otto**, German author, critic and poet: b. Krotoschin, Posen, 19 April 1824; d. Darmstadt 18 March 1896. Educated at Heidelberg, Berlin, and Halle, he taught at Dresden until his 39th year, at Berlin in 1862-9, and then in the Darmstadt Technische Hochschule, where he was professor of German language, literature, and history. He wrote an excellent history of German literature (1872; 3d ed. 1879); the novels, 'Im Haus der Väter,' 'Das Buchstabirbuch der Leidenschaft,' and 'Die Prophetenschule'; two volumes of dramatic poems (1867-76), and lyrics and tales.

Roraima, rô-râ'ê-mâ, a mountain of South America, in lat. 5° N., on the boundary of British Guiana and Venezuela. It is 8,740 feet high, the top forming a rugged rocky plateau, and the steep rocky sides render the summit almost

inaccessible. It was ascended in 1884 by Mr. Everard im Thurn. The flora and fauna of the summit are scanty.

Ro'rer, Sarah Tyson, American teacher of domestic science: b. Richboro, Pa., 18 Oct. 1849. She was graduated from the academy at East Aurora, N. Y., and was married in 1871 to W. A. Rorer. She was for many years principal of the Philadelphia School of Domestic Science, and has lectured widely. She was editor and part owner of 'Table Talk' in 1886-92, edited 'Household News' in 1893-7, and since then has been on the editorial staff of the 'Ladies' Home Journal.' She is also director of the Pennsylvania Chautauqua School of Domestic Science. Her publications include: 'Mrs. Rorer's New Cook Book'; 'How to Use a Chafing Dish'; 'Colonial Cookery'; 'A Book on Diet and Cookery'; etc.

Ro'ric Figures (Fr. *figures roriques*, from Lat. *ros*, dew), a name applied to certain curious images rendered manifest upon breathing on polished solid surfaces, when these have been previously exposed to contact or close proximity of the objects thus represented, and usually at the same time acted upon by light, heat, or electricity. The singularity of these phenomena is, that they consist usually in the production at the first of a sort of latent or invisible image, but this may afterward be developed or brought out, somewhat in the manner of photography.

Rorkes (rôrks) Drift, Africa, a post station on the Tugela River, in Natal, memorable for the heroic defense of a British force of 80 men under Lieutenants Bromhead and Chard. They were guarding the hospital and the commissariat, when they were attacked by a Zulu force of 4,000, the night of 22 Jan. 1879. The British used biscuit boxes and rice bags for a barricade, and kept the enemy at bay until relieved the morning of the 23d. Six times in succession the little force drove out Zulu warriors who had got within the barricade.

Rorqual, rôr'qwal, a name which is of Scandinavian origin, and signifies a whale having longitudinal furrows on the belly. As generally employed, it comprises the finback, sulphurbottom, and humpback whales, or the subfamily *Balenopterinae*, exclusive of the genus *Rhachianectes*. The sulphurbottom is a particular kind of finback, characterized by great size, a mottled coloration, and various osteological peculiarities. In the North Atlantic there are three species of finbacks, one species of sulphurbottom, and one species of humpback. The finbacks are the common finback (*Balenoptera physalus*), the pollack whale (*B. borealis*), and the little piked whale (*B. acuto-rostrata*). The whale which is most frequently seen on the east coast of the United States, and of which stranded individuals are found every year at different points, is the common finback, *B. physalus*. It is from 60 to 70 feet long when full-grown, and is readily distinguishable by its gray and white striped whalebone, gray upper surfaces, and white belly, and under surfaces of pectoral fins and flukes. The dorsal fin, which is rather more than a foot high, is situated a little in advance of the last fourth of the length of the body. Though numerous

species of finbacks and humpbacks have been described from different parts of the world, the five forms above mentioned are everywhere recognizable. If others exist they at least resemble these very closely. The sulphurbottom feeds on small crustaceans, and the finbacks and humpbacks on various fishes, such as the cod, pollack, herring, capelin, etc. They all engage in seasonal migrations. During the summer months great numbers congregate about Newfoundland, Iceland, and the north of Norway. For gray whale, or hardhead, and further information relating to finbacks and humpbacks, see WHALE.

Rory O'More, rô'ri ô-môr', a novel by Samuel Lover, published in 1836. In spite of its stilted style and improbable incidents, this story is valuable in its delineation of Irish character, and in its picture of the Irish uprisings at the close of the 18th century.

Rosa, rô'zä, Carl Augustus Nicholas (originally ROSE), German opera conductor: b. Hamburg 22 March 1842; d. Paris 30 April 1889. He studied violin playing at Leipzig, made a tour at 12; and gained the violin prize at the Paris Conservatoire. He came to America as conductor of Mr. Bateman's concert tour, and met the singer Euphrosyne Parepa, to whom he was married in 1867. His opera company, headed by Mme. Parepa-Rosa, included Wachtel, Santley, Ronconi, and Formes. In 1871 he became manager of the Carl Rosa Opera Company in London and produced operas in English both in London and in the provinces until his death.

Rosa, rô'sä, Salvatore or Salvator, Italian painter: b. Renella, near Naples, 20 June 1615; d. Rome 15 March 1673. His eldest sister having married Francesco Francanzano, a painter, Salvator from him acquired a taste for art. He then became a pupil of Falcone and Ribera (q.v.). But his taste was formed by the study of nature among the wilds of the Apennines rather than by other artists. During one of his rambles in the Abruzzi he was seized by brigands with whom he is said to have associated for some time, but left them at last and went to Naples, where he worked in such want that he was often obliged to sell his pictures to the meanest hucksters and for a pittance. At last one of his pictures was observed by the painter Lanfranco, who recommended Salvator to notice, and procured him patronage. He removed to Rome, where he established his reputation. In 1647, when the revolt under Masaniello occurred, he joined *La Compagnia della Morté*, which Falcone commanded, and on the defeat of the cause he returned to Rome, where he was not, however, permitted to remain. He went to Florence, where he was patronized and employed by the grand duke and other members of the family of Medici. At length, returning to Rome on the death of his enemies, he painted many pictures for the churches in that city. His great ambition was to be a famous historical painter, but he is actually best known as a painter of landscapes and battles. His landscapes present wild and desolate scenery; with rocks rising like towers, broken, splintered tree trunks waving their leafless arms; storm and lightning convulse the heavens, and the figures introduced are those of bandits, soldiers, or witches. Among

his extant works are: 'Prometheus,' 'Belisarius,' 'St. Roche Wounded,' some landscapes and battle-scenes, in Rome; 'Jesus Disputing with the Doctors,' 'Daniel in the Lions' Den,' 'Jesus Walking on the Water,' in Naples; 'Souls in Purgatory,' in Milan; 'Conspiracy of Catiline,' and his own portrait, in Florence; 'The Soldiers of Gideon,' 'Bandits in Council,' 'St. Jerome in the Desert,' and some landscapes, in Munich; 'Mercury and the Woodman,' 'Landscape with Figures,' in the National Gallery; 'Moses at the Rock,' 'Halt of the Soldiers,' at Hampton Court; 'Prometheus,' 'Sisyphus,' at The Hague; 'Regulus,' 'Cadmus,' at Copenhagen; 'The Prodigal Son,' in St. Petersburg; 'The Angel Raphael' and 'The Young Tobias,' 'The Shade of Samuel Appearing to Saul,' in the Louvre; 'Jesus in the Garden of Olives,' 'Resurrection of Christ,' in Toulouse. He was distinguished as a poet and musician and his satires and other poems have been often printed.

Ro'sa America'na, in numismatics, the name applied to a coinage issued in 1722 by Great Britain for America of a mixed metal resembling brass, and called Rosa Americana or Wood's money, after its manufacturer, William Wood. The royal letters patent described this money as two-pence, pence, and half-pence. See NUMISMATICS.

Rosa, Monte, mōn'tě rō'sā (ancient Mons SYLVIVS), a mountain of the Alps (q.v.), on the boundary between Italy and Switzerland, near the Matterhorn, and about 40 miles east of Mont Blanc (q.v.). It is formed by the union of several mountain ridges. Where the ridges meet four chief angles are formed, the one on the northeast, which is most precipitous, enclosing the glacier of Macugnaga, another on the northwest originating the great Gorner glacier or glacier of Zermatt, a third on the southwest containing the glacier of Lys, and the fourth on the southeast occupied by several large but less prominent glaciers. The loftiest peak, Dufourspitze, 15,217 feet in height, was first ascended in 1855. There are three other peaks, respectively 15,132, 15,005, and 14,665 feet high.

Rosaceæ, rō-zā'sē-ē, the Rose family, a natural order of herbaceous plants, shrubs, and trees, with alternate simple or compound leaves accompanied at their base by two persistent stipules. Many of our commonest edible fruits belong to this order, such as strawberries, raspberries, brambles, plums, apples, quinces, cherries, almonds, peaches. They have a calyx of one sepal, with four or five divisions, and the corolla has as many petals as the calyx has divisions, but is sometimes wanting. The stamens are generally very numerous and distinct, and are inserted with the petals round the ovary. The pistil presents various modifications. Sometimes it is formed of a single carpel or several entirely free and distinct carpels, placed in a tubular calyx. Sometimes these carpels adhere by their outer side to the calyx; sometimes they are united, not only to the calyx, but to each other; and sometimes they are collected into a kind of capitulum or head. The fruits, consequently, are highly varied, and their modifications afford the chief distinguishing marks of the sub-orders. In Engler and Prantl's 'Pflan-

zenfamilien' the *Rosaceæ* are divided into 13 tribes, and these tribes are grouped in six sub-orders. The sub-order *Spiræoideæ* comprises the tribes *Spirææ* (queen-of-the-meadow), *Quilla-jææ* (soap-tree), and *Holodisceæ*. The tribe *Pomoideæ* (apple, pear, etc.), forms a sub-order by itself. Under the sub-order *Rosoideæ* are classed the tribes *Kerriæ* (*Kerria japonica*), *Potentillæ* (raspberry, strawberry, etc.), *Cercocarpeæ*, *Ulmariæ*, *Sanguisorbeæ* (lady's-mantle, etc.), and *Roseæ* (roses). *Neuradoideæ*, *Prunoideæ* (sloe, etc.), and *Chrysobalanoideæ* (cocoa-plum), are tribes each of which constitutes a sub-order. The plants of this order are chiefly found in the cold and temperate climates of the northern hemisphere.

Rosacea, Acne Rosacea, or Gutta Rosea. See ACNE.

Rosales, rō-sā'lēs, Philippines, pueblo, province of Nueva Ecija, Luzon; on a tributary of the Agno River, two miles from its junction with the Agno; 38 miles north of San Isidro. It is connected by highway with Manila and with towns to the north. Pop. 11,519.

Rosamond, rōz'a-mōnd, English mistress of Henry II., commonly called "Fair Rosamond." She was the daughter of Walter, Lord Clifford, became the mistress of Henry II., and died probably about 1176. The king is said to have set apart for her residence a building surrounded by a labyrinth at Woodstock. The intrigue was finally discovered by the jealous Queen Eleanor, who forced her to drink poison. These details, however, have no historic basis. She was buried in the chapter-house of Godstowe nunnery, where her tomb was long to be seen.

Rosan'iline, a derivative of aniline (q.v.), the base of magenta, fuchsine (qq.v.), etc. It is a colorless substance, having the formula $C_{10}H_7N_3O_2$. Many of its crystalline salts are of very brilliant colors.

Rosario, rō-sā'rē-ō, Argentina, in the province of Santa Fé, on the right bank of the Paraná, lies 160 miles northwest of Buenos Ayres. It is the second city of the republic in commercial importance, and the centre of the entire trade for the 11 provinces lying between Paraná and the Andes. Many handsome buildings are of recent construction, such as the new courts, theatre, banks, and hotels. Other improvements, such as telephone, and a new railway from the capital opening up a new and vast territory, adduce to its rapid development and progress, and it is virtually a rival of Buenos Ayres. Exports, agricultural products, were valued at more than £5,850,000. Pop. about 118,000.

Rosario, Philippines, pueblo, province of Batangas; on the southeastern coast at the mouth of the Rosario River; 13 miles northeast of Batangas, the provincial capital. It is an important road centre. During the last insurrection the town was destroyed by the insurgents. Pop. 12,450.

Also the name of two smaller pueblos in Luzon: (1) in the province of Cavite, on the Manila coast road, eight miles southwest of the town of Cavite, pop. 6,390; (2) in the province of Unión, situated in a mountainous district, 30

ROSARY OF THE BLESSED VIRGIN MARY — ROSCIUS

miles southeast of San Fernando, connected with coast highway; pop. 2,250.

Rosary of the Blessed Virgin Mary, a popular and highly approved form of devotion in the Roman Catholic Church. It consists in the recital of 15 decades of Aves (see AVE MARIA) each decade preceded by a Paternoster and followed by a Gloria (see DOXOLOGY): as the prayers are said, they are counted off on a string of beads. Five decades form a chaplet and in each chaplet are contemplated events or "mysteries" connected with the life of Christ: the mysteries of the first chaplet are, the Annunciation, Visitation, Birth of Christ, his Presentation in the Temple, and his Finding there: these are the Joyful Mysteries. In the other chaplets are contemplated the Five Sorrowful Mysteries — the Agony in the Garden, Scourging, etc.; and finally the Five Glorious Mysteries — Resurrection, Ascension, etc. The Rosary of 15 decades was introduced by St. Dominic in the 13th century.

Rosary Sunday, the first Sunday in October; a feast instituted by Gregory XIII. for the Confraternity of the Rosary, and made of universal observance after the victory of the Emperor Charles VI. over the Turks at Lepanto in 1571, in gratitude to the Blessed Virgin. This victory is supposed to be in answer to the prayers of the Fraternity of the Rosary, a Roman Catholic order established in the 15th century for the purpose of averting public calamity by the means of prayers. An impetus was also given to the devotion of the rosary by Leo XIII., who enjoined its daily use in public during October. Roses are blessed and distributed as souvenirs, and the rosary is recited continually during the day.

Rosas, Juan Manuel de, hoo-än' mā-noo-ël dā rō'sās, Argentine dictator: b. Buenos Ayres 30 March 1793; d. near Southampton, England, 14 March 1877. He was descended from a noble family of Spain and first came into public notice as leader of the republicans against the aristocratic party of the Unitarios. He was commander of the police of Buenos Ayres in 1826, but the revolution headed by Lavalle forced him to retire. He succeeded a little later in overcoming Lavalle and becoming governor, 1829-32. Though forced out of office he held control of the army and in 1835 became dictator for five years. His appointment was twice renewed and until 1852 no meetings were held of the national congress or the constituent assembly. Rosas exercised a despotic rule and attempted to annex the neighboring states by force under the pretext of their formerly belonging to the vice-royalty of Buenos Ayres. He took advantage of the rivalry of Oribe and Rivera to intervene in the affairs of Uruguay, made an unsuccessful invasion in 1839 after the fall of Oribe's government and repeated the attack in 1843. A long siege followed and the closing of the Paraná to navigation, and the violation of the treaties of 1828 and 1840 finally led to combined interference on the part of England and France. Buenos Ayres was blockaded, but little was effected save the opening of the Paraná, as the river provinces could not be induced to rise against Rosas. England withdrew in July 1848 and France six months

later. The opposition party against Rosas was growing more powerful, however, and the treaty of 1849 which denied to the neighboring provinces navigation privileges of the Plate, the Uruguay, and the Paraná finally brought to his opponents the support of Brazil, and Rosas was defeated at Monte Caseros, 3 Feb. 1852. He made his escape to England, where he lived the remainder of his life. The Argentine congress passed sentence of death upon him in 1861 as "a professional murderer and robber."

Roscelin, rös-ël-än, **Rousselin**, or **Rucelin**, **Jean**, French theologian of the 11th century: b. probably in the diocese of Soissons. He was educated at Rheims, and came into public notice while canon of Compiègne by citing Anselm as supporting his view of the Trinity, which in effect conceived God as existing as an individual and consequently the Trinity as three Gods. The synod of Soissons in 1092 compelled Roscelin to recant, after receiving from Anselm a refutation and denial of Roscelin's position and claims. Continuing to teach his peculiar views he was deposed. He went to England to attack Anselm, then archbishop of Canterbury, at the opportune moment of his difference with the king, but failing in his purpose returned to France. Later he settled at Tours and entered into a controversy with Abelard, his former pupil, on the grounds taken by the latter in maintaining the unity of the Trinity. After this controversy Roscelin disappears from history. Of his writings only a letter to Abelard is extant. In the history of philosophy he is classified as a nominalist and in theology as a tritheist.

Roscher, rōsh'ēr, **Wilhelm**, German political economist: b. Hanover 21 Oct. 1817; d. Leipsic 4 June 1894. Following Savigny, who introduced into Germany the historical treatment of jurisprudence, Roscher broke with the theoretical economists and entered on the study of the history of economics, treating political economy less as an abstract science and more as a branch of history, and making economic fact and past development rank mere economic ideas and theories. From 1848 he was professor at Leipsic. His two great works are: 'System der Volkswirtschaft' (1854-81); and 'Geschichte der Nationalökonomik in Deutschland' (1874).

Roscius, rōsh'ī-ūs, Roman actor: b. Colonium, near Lanuvium, 134 B.C.; d. about 61 B.C. He was born a slave and early adopted the histrionic profession for his master's profit. His success on the stage was phenomenal. It is said that at one time he earned 1,000 denarii (about \$175) daily, and Pliny estimates his annual profits at 50,000,000 sesterces (about \$2,000,000). This may be exaggerated, but he was a favorite actor at a period when the Roman passion for the stage was at its height. He was easily enabled to purchase his freedom from his *peculium*, or perquisites as a slave, took the name of Quintus Roscius Gallus, and wore the emblem of equestrian rank, a gold ring, given him by Sulla. The Roman populace and nobles he moved with equal facility to tears or laughter by his irresistible histrionic power, for while he was a tragedian unparalleled in the history of the ancient Roman stage, he was also a comedian of fresh and natural humor. Cicero did not disdain to receive instructions from the great

actor, whom the first orator of Rome always spoke of in terms of affection and admiration.

Roscoe, rōs'kō, Sir Henry Enfield, English chemist: b. London 7 Jan. 1833. He was educated at University College, London, and at Heidelberg, making a special study of chemistry. He occupied the chair of chemistry at Owens College, Manchester, in 1857-87, since when he has been emeritus professor there. He was knighted in 1884, sat in Parliament for South Manchester in 1885-95, and in 1896-1902 was vice-chancellor of the University of London. He has received high honors from the universities and learned societies of England and has published: 'Investigations on the Chemical Action of Light'; 'Lessons in Elementary Chemistry' (1871); 'A Treatise on Chemistry' (1878-89); 'The Hydrocarbons and their Derivatives,' with Schorlemmer (1881-92); etc.

Roscoe, William, English biographer: b. near Liverpool 8 March 1753; d. Toxteth Park, Liverpool, 30 June 1831. At 16 he was articled to an attorney in Liverpool, and this obliging him to study Latin, he read and made himself master of the Latin classics. He next studied the Italian and French languages, and in the former became uncommonly proficient. Having finished his clerkship, he was taken into partnership by an attorney of considerable practice and carried on the whole of his business. In 1777 he published a collection of some of his earlier poems and when the question of the slave-trade came uppermost Roscoe took a warm part in favor of its abolition, and joined Clarkson in his endeavors to that end. His 'Scriptural Refutation of a Pamphlet on the Licitness of the Slave-Trade' and his 'Wrongs of Africa,' appeared in 1788; and in 1796 he brought out the work which gained him celebrity, the 'Life of Lorenzo de' Medici, called the Magnificent' (1795), since translated into Italian, French, and German. About 1797 Roscoe retired from the practice of an attorney, and entered himself as a student of Gray's Inn, with a view to the bar. He published the 'Life and Pontificate of Leo X.' in 1805, and in 1806-7 represented Liverpool in Parliament. He had previously entered into business at Liverpool as a banker, a move which eventually landed him in great pecuniary difficulties. He was the author of several political pamphlets, and the mover and supporter of several public works in Liverpool. To the botanic garden and to the Athenæum he lent much effective assistance. Consult his 'Life and Correspondence' (1833) by his son, Henry Roscoe.

Rose, rōz, Chauncey, American philanthropist: b. Wethersfield, Conn., 24 Dec. 1794; d. Terre Haute, Ind., 13 Aug. 1877. In 1825 he settled in Terre Haute as a merchant, where by his investments in land he became wealthy. He was an active promoter of railroad interests and was especially interested in the Terre Haute and Indianapolis Railroad. Though legally entitled to the fortune of his brother John he disposed of almost the entire amount of \$1,600,000 in benevolent enterprises which he knew his brother to have favored, and later founded from his own fortune the Rose Polytechnic Institute to which he left the greater share of his estate.

Rose, Frank H., English engineer and journalist: b. Lambeth, England. He was educated in the London elementary schools and in the night classes, served as an engineer's apprentice in 1872-8, and then joined the Lambeth Society of Amalgamated Engineers. He gained a considerable influence over industrial thought of the day, was almost constantly an officer in the Amalgamated Engineers, living in Liverpool and in Manchester in 1893-1903 as a district organizer, since when he has entered upon a political and journalistic career.

Rose, George ("ARTHUR SKETCHLEY"), English dramatist and novelist: b. London, England, 19 May 1817; d. there 11 Nov. 1882. He was graduated from Oxford in 1845, took orders in the Church of England in 1848, and after holding several curacies became in 1855 a Roman Catholic. He then engaged in tutoring and later devoted himself to a literary career in which he achieved a considerable success. His 'Mrs. Brown' monologues were published in 32 volumes (1866-70) and enjoyed wide popularity. His other works include: novels, 'A Match in the Dark' (1878); and 'A Marriage of Conscience' (1879); plays, 'The Dark Cloud' (1863); 'How Will They Get Out of It?' (1864); 'Money Makes the Man' (1870); and also several works of travel, 'The Great Country, or Impressions of America' (1868); 'Out for a Holiday' (1870); etc.

Rose, rō'zē, Gustav, German mineralogist, brother of Heinrich Rose (q.v.): b. Berlin 28 March 1798; d. there 15 July 1873. He studied under Berzelius at Stockholm, in 1822 became keeper of the mineralogical collection in the University of Berlin, and in 1826 was made extraordinary and in 1839 ordinary professor of mineralogy in that institution. Beside several essays in Poggendorff's 'Annalen,' he wrote 'Elemente der Krystallographie' (1833); 'Ueber das Krystallisationsystem des Quarzes' (1846); 'Das krystallochemische Mineralsystem' (1852). With Humboldt and Ehrenberg he made in 1829 a journey to northern Asia, an account of which he gave in a work entitled 'Reise nach dem Ural, dem Altai und dem kaspischen Meer' (1837-42).

Rose, Heinrich, German chemist: b. Berlin 6 Aug. 1795; d. there 27 Jan. 1864. He first devoted himself to pharmacy, studied in Berlin, in Stockholm in 1819 under Berzelius, and from there went to Kiel, where he took his degree. In 1823 he became extraordinary and in 1835 ordinary professor of chemistry at Berlin. As a practical analyst in the department of inorganic chemistry he holds a high rank, and the result of his labors can be found in his memoirs inserted in the 'Annalen' of Poggendorff. His 'Manual of Analytical Chemistry' (1829) was translated into French, English, and Swedish. In 1844 he discovered a new metal in the tantalites of Bavaria which he called niobium.

Rose, rōz, Sir Hugh, LORD STRATHEARN, English diplomatist: b. Berlin 8 March 1803; d. Paris 16 Oct. 1885. He entered the British army in 1820, was military attaché to the Turkish army in 1840, was consul-general for Syria 1841-8, as secretary to Lord Stratford de Redcliffe was *chargé d'affaires* at Constantinople in 1852-4, and was commissioner at the French

ROSE—ROSE OF JERICO

headquarters during the Crimean war. He was sent to India in 1857 to command the Central Indian army, and virtually reconquered Central India. Though his campaign was overshadowed by that of Sir Colin Campbell, it is generally admitted that his operations were more skilful and brilliant than his chief's, on whose death he became commander-in-chief in India. He held the same post in Ireland 1865-70, was raised to the peerage in 1866, and made field-marshal in 1877.

Rose, Hugh James, English theologian: b. Little Horsted, Sussex, 1795; d. Florence 22 Dec. 1838. He was graduated from Trinity College, Cambridge, in 1817; and elected professor of divinity to the University of Durham in 1833. He was one of the leaders of the Oxford movement, and it was at his rectory, Hadleigh, Suffolk, in July 1833, that a resolution was made to publish 'Tracts for the Time.' "He was," says Dean Church, "the most accomplished divine and teacher in the English Church. He was really a learned man. He had the intellect and energy and literary skill to use his learning. He was a man of singularly elevated and religious character; he had something of the eye and temper of a statesman, and he was profoundly loyal to the Church." It is not too much to say that by his early death the Tractarian movement lost its balance wheel. See OXFORD MOVEMENT. Consult: Church, 'The Oxford Movement' (1891); Mozley, 'Reminiscences.'

Rose, Sir John, Canadian financier: b. Turiff, Aberdeenshire, 2 Aug. 1820; d. Caithness-shire 26 Aug. 1888. He was educated at King's College, Aberdeen, and in 1836 removed with his parents to Canada. He served as a volunteer during the rebellion of 1837, in 1842 was admitted to the bar, and soon established a large practice at Montreal. He entered Parliament as member for Montreal in 1857, and after the Union until his retirement in 1869 represented Huntingdon. He was solicitor-general in 1857, minister of public works in 1859, and in 1864 was appointed commissioner for the settlement of claims under the Oregon treaty with the United States. In 1867-9 he was minister of finance, then retired from office, went to England and engaged in banking. He represented the English government on a confidential mission to the United States which led to the treaty of Washington in 1870, and until his death was regarded as the unofficial representative of Canadian interests in England. He was created a baronet in 1872 and in 1886 became a privy-councillor.

Rose, Attar of. See ATTAR.

Rose-breasted Grosbeak. See GROSBEAK.

Rose-chaffer. See GRAPE INSECT PESTS.

Rose Festival, a peculiar kind of festival which is celebrated annually on 8 June in some French villages. A similar gala-day is celebrated in Los Angeles, Cal., annually in June.

Rose-mallow. See HIBISCUS.

Rose-noble, an English gold coin of the value of \$1.65, first struck by Edward III., in 1334, and so called because it was of the same value as the noble, a money of account, and was stamped on one side with the figure of a

rose. It ceased to be coined in the reign of Henry V.

Rose, Order of the. See ORDERS, ROYAL.

Rose Polytechnic Institute, an institution of collegiate grade at Terre Haute, Ind. Its organization was begun as early as 1874, but it was not opened to students until 1883. It is governed by a board of nine members, of whom one is an alumnus elected by the alumni. The institute offers four courses, each of four years' duration. They are in mechanical engineering, electrical engineering, civil engineering and architecture, and chemistry. From the first the practical work in the institute shops has been an important feature of the curriculum. The degree of bachelor of science is conferred for the completion of any of these courses; that of master of science, two years after graduation if one year is spent in graduate study; the degrees of mechanical engineer, electrical engineer, or civil engineer are conferred upon those who have the master's degree after two years' successful professional work. The grounds and buildings of the institute are valued at \$145,000, the library contains 15,000 volumes (1910). The original endowment from the founder, Chauncey Rose, was over \$500,000, and additions to this fund have since been made; the annual income in 1910 was \$42,000. The students numbered 200, and the faculty 22.

Rose Window, a circular window, divided into compartments by mullions and tracery radiating from the centre, also called Catharine wheel and marigold window according to modifications of the design. It forms a fine feature in the church architecture of the 13th and 14th centuries, and is mostly employed in the triangular spaces of gables. In France it is much used, and, notwithstanding difficulties of construction, attained great size. Notable examples are found in the windows in the cathedrals of Amiens, Chartres, Paris, and in that of Rheims Cathedral, which is over 40 feet in diameter.

Rose-wood, the commercial name for chestnut-colored, dark-veined woods, brought chiefly from Brazil, of varying origin, but mainly the product of *Dalbergia nigra*, one of the *Leguminosæ*. It is imported, not in logs or planks, since the large heart-wood rots easily, but in segments, and is sold by weight, being valued according to its richness of color. When cut it gives out a faint rose-odor, and is fine and hard, takes a high polish, and is much in demand for cabinet making and pianos, being used solidly and in veneer, although somewhat difficult to work on account of its resinous veinings.

Rose of Jericho, or **Resurrection Plant**, a small, annual, cruciferous plant (*Anastatica hierochuntina*) which grows in the desert regions about the Red Sea. It bears minute white flowers succeeded by tiny pods, containing a few seeds. When the seeds are ripe, the leaves fall off, the branches curl inward and interlace, enclosing the pods still holding their seeds, and become dry and rigid, causing the plant to assume the form of a ball, ready to be blown hither and thither by the winds of the dry season. When the plant is deposited in a damp place, it exercises its remarkable hygroscopic powers, rapidly uncoils, and lets the seed escape

ROSE OF LIMA — ROSEBURG

in soil suitable for germination. This habit of curling up when dry, and rapid absorption of water, forcing the apparently dead limbs to spread open, as if alive again, has caused the plant to be collected and sold as a curiosity.

Rose of Lima, Saint, a religious woman of Spanish America: b. Lima, Peru, 1586; d. there 24 Aug. 1617. Her baptismal name was Isabel, but from her fine complexion she was given the name of Rose. She early showed herself resolute in avoiding the self-indulgence of society and the world. As a symbol of the life she had chosen she planted her garden only with bitter herbs and interspersed them with figures of the cross. In her religious exercises she took the great mystic, Catharine of Siena, as her model. When her parents fell into poverty she was taken into the family of the treasurer Gonsalvo, by the devout wife of that gentleman, and by her labor day and night supplied the necessities of her parents. When she was importuned by her friends to marry, she refused, and as her duty to her parents forbade her taking the veil, she emphasized her refusal by joining the Third Order of Saint Dominick, and the religious strictness and exalted piety of her life was an example which won the admiration, sometimes the imitation, of the worldly and profane. On her death the chapter of the cathedral, the senate, and all the most honorable companies of the city took turns in carrying her body to the grave. She was canonized by Clement X. in 1671 and 30 August was appointed for her festival.

Rose of Lippe, The. See ORDERS, ROYAL.

Rose of Sharon, a name given to an ornamental malvaceous shrub, the *Hibiscus syriacus*. But the rose of Sharon of the Bible was doubtless a bulbous plant, probably a kind of narcissus. See HIBISCUS.

Ro'seate Spoonbill. See SPOONBILL.

Roseate Tern. See TERN.

Rosebery, rōz'bér-ī, **Archibald Philip Primrose**, EARL OF, English statesman and author: b. London 7 May 1847. He was educated at Eton and Oxford; became Earl of Rosebery in 1868; as a member of the House of Lords entered his political career without the advantage of a training in the Commons, but soon proved himself a brilliant debater; in 1872 was a commissioner on Scottish endowments; and was successively rector of the great Scottish universities of Aberdeen (1878-81) and Edinburgh (1882-3). From August 1881 to June 1883 he was under-secretary of state for the home department, in 1884 became first commissioner of works, and in 1886 was appointed secretary of state for foreign affairs in Gladstone's government. He was generally approved for his skilful treatment of the difficult questions connected with the war between Bulgaria and Serbia, and the coercion by the European concert of Greece, then threatening war with Turkey. He was also one of the firmest supporters in the Upper House of Gladstone's first Home Rule bill. With the defeat of the bill, and of the government at the general election, he passed from office. He soon, however, entered upon a new activity, and one with which up to his time peers had been supposed to have nothing to do,—namely the municipal business of London.

Upon the organization of the London county council, a representative body, chosen by popular suffrage and responsible to the public, he at once enlisted himself in the service of the improved system of government promised thereby, on 17 Jan. 1888 became a member of the council, and on 12 February was made its chairman. In June 1890 he resigned. Following his example, many others of rank and prominence entered the council, whose work was raised to an important position in English public life. For some months in 1892 he was again president of the council. Upon Gladstone's accession to power in that year, he once more became secretary for foreign affairs. He maintained a strong advocacy of Imperial federation; made in September 1894 a notable and characteristic speech before the Lords on the Home Rule bill, which, though passed by the Commons, was thrown out by the Upper House after a four-days' discussion; and brought to a satisfactory end the serious coal strike of 1893. When Gladstone finally retired from political life in 1894, Rosebery was summoned to form an administration, notwithstanding that there were other Liberals whose length of service was thought by many to give them precedence. Many influential Liberals objected, too, it was said to a prime minister without the House of Commons. No remarkable events attended his administration. The Liberal majority was not large; and before long there were evidences of an increasing division within the party, due in large measure to opposition to his supposed imperialistic views. His government was once or twice discomfited, and finally on 21 Jan. 1895 was defeated in the committee on army estimates. He resigned on 22 January and became the leader of the Liberal opposition. In October 1896 he resigned even this position. He had made several of his finest speeches, but found himself at apparent odds with the majority of his party. In May 1898 he spoke eloquently on Gladstone before the House of Lords, and in 1899 was elected lord rector of Glasgow University. He is distinguished for his many and varied attainments, and as a ceremonial and commemorative orator is unequalled in England. Marked characteristics of his speeches are their literary quality, derived from a very extensive reading, and that skilful irony whose presence he has so admirably indicated in the writings of Stevenson. As an author, he is known for his 'Life of William Pitt' (1891), already becoming a sort of classic; a 'Life of Sir Robert Peel' (1899); and 'Napoleon: The Last Phase' (1900), a most careful and interesting narrative of the captivity at St. Helena, with a severe arraignment of English blunders in the treatment of the emperor. Consult the 'Life and Speeches' (1900) by Coates, a eulogy throughout; also the collection, 'Appreciations and Addresses' (1899). See GREAT BRITAIN, History.

Roseburg, rōz'bèrg, Ore., city, county-seat of Douglas County; on the Umpqua River, and on the Southern Pacific railroad; about 200 miles south of Portland. It is the commercial and trade centre for the fertile valley of the Umpqua, in which farming, fruit-growing, stock-raising, and mining are carried on. The chief manufactures are flour, dairy products, canned

ROSECRANS — ROSENTHAL

fruits, beer, wagons and carriages. It has the Oregon State Soldiers' Home. Pop. (est.) 1,800.

Rosecrans, rō'zē-krānz, **William Starke**, American soldier: b. Kingston, Ohio, 6 Sept. 1819; d. near Redondo, Cal., 11 March 1898. He was graduated at West Point, entering the army as 2d lieutenant of engineers in 1842, but in 1844 returned to West Point as assistant professor of engineering. From 1847 to 1854 he superintended the repair of various harbors on the eastern coast, but resigned his commission in the last named year, and retired to private life in Cincinnati, where he became a consulting engineer and architect. He entered upon his career in the Civil War in the volunteer army, his first service being the organization of the Ohio troops. From colonel of the 23d Ohio Volunteers, he was promoted brigadier-general, U. S. V., in May 1861, and 23 June was placed in command of three brigades under McClellan in the campaign of western Virginia, where he was victor in the battles of Rich Mountain and Carnifax Ferry. He served in the Department of Western Virginia until he succeeded Gen. Pope in command of the Army of the Mississippi. After successfully defending Corinth in western Tennessee during the siege of 11 June 1862, he was put in command of that district by Gen. Grant, with headquarters at Jackson, Tenn. His memorable career as commander of the Army of the Cumberland began in October 1862, and in June 1863 he moved upon the Confederate army under Gen. Bragg, whose forces he had been holding in intrenchment during the Northern victory at Vicksburg, causing Bragg's retreat over the Cumberland Mountains to Chattanooga. In the battle of Chickamauga, 19-20 Sept. 1863, Rosecrans was badly defeated. He was soon after transferred to the Department of the Missouri, and in 1864 relieved of his command. He retired to Cincinnati, where he remained until 1868, when he was appointed minister to Mexico. In 1865 he was brevetted major-general in the United States army. In 1881-5 he represented California in Congress. From 1885 to 1893 he was register of the United States Treasury, and his beautiful signature is to be seen on the treasury notes of that period. He was restored to the rank of brigadier-general and placed on the retired list of army officers in 1898.

Rosefish, a large red fish (*Sebastes marinus*) of the rockfish family (*Scorpanidae*), taken numerous on far northern coasts, where it frequents shallow shore-waters, while southward it remains at considerable depths. It bites readily to hand or trawl lines, its flesh is good and it is profitable for market as it reaches a length of two feet. Its color is orange-red. Many local names belong to it, as red perch, snapper, Norway haddock, hemdurgan, etc. The rosefish feeds upon crustaceans, small fish, and mollusks; and the young, at least, are among the most important food-resources of cod and halibut.

Rosemary, a shrubby, strongly aromatic plant (*Rosmarinus officinalis*), growing wild in the southern parts of Europe and also cultivated. It belongs to the Mint family (*Labiata*) and has axillary, pale blue flowers with two stamens.

The stem is three or four feet high, bearing opposite, linear and sessile leaves with revolute margins which are dark-green, smooth and shining above, white and cottony beneath. Rosemary is tonic and slightly stimulant, and formerly enjoyed considerable reputation as a medicine. It yields, by distillation, a light pale essential oil of great fragrance, which is used in hair pomades. The herb is also used for seasoning in Italy. Rosemary is often referred to in folk-lore: it was supposed to restore youth when eaten; it was woven into brides' wreaths, and otherwise employed at weddings, and was carried to funerals and thrown on the graves, because, as it did not soon fade, it was a symbol of remembrance. "There's rosemary, that's for remembrance."

Rosenau, rō'zē-now, **William**, American rabbi and educator: b. Wollstein, Germany. After coming to America he studied in the public schools of Philadelphia and Cincinnati and was graduated from the Hebrew Union College in Cincinnati in 1889. He was rabbi in Omaha, Neb., 1889-92, and has been rabbi in Baltimore since 1892. He has been instructor and is now associate in rabbinica at Johns Hopkins University and among his publications are: 'Semitic Studies in American Colleges'; 'Hebraism in the Authorized Version of the Bible'; 'Jewish Ceremonial Institutions and Customs.'

Rosendale, rō'zēn-dāl, N. Y., village in Ulster County; on the Rondout River, the Delaware & Hudson Canal, and the Walkill Valley Railroad; about eight miles south by west of Kingston (q.v.). It is noted for its manufacture of hydraulic cement (q.v.). Most of the cement derived from the natural cement rock, in the United States, comes from Rosendale. Pop. (1910) 1,125.

Rosenfeld, rō'zēn-fēlt, **Sydney**, American dramatist: b. Richmond, Va., 26 Oct. 1855. Educated in the public schools of Richmond and New York, he early displayed a fondness for literature and play-writing, and some of his dramas have won fair success. Among the plays of which he is author in whole or in part are: 'The Senator'; 'A Possible Case'; 'A House of Cards'; 'The Passing Show'; 'Lady or Tiger.' He has also adapted 'The Black Hussar'; 'Nanon'; 'Prince Methusalem'; etc.

Rosenthal, rō'zēn-tāl, **Max**, American artist: b. Turck, Russian Poland, 28 Nov. 1833. At 14 he studied art in Paris, and coming to Philadelphia in 1849, he entered the Academy of Fine Arts, chromo-lithography being his specialty. In 1861 he followed the Army of the Potomac and executed drawings of every camp until Gettysburg. Some of his best work is seen in illustrated plates of the report of the United States Military Commission to the Crimea (1860) and in Dickinson's 'Numismatics of the United States.'

Rosenthal, **Toby Edward**, American painter: b. New Haven, Conn., 15 March 1848. He studied at Munich in the studio of K. Raupp (q.v.) and in 1868 came under the instruction of Piloty. After producing many genre pictures he attracted attention by his 'Sebastian Bach and his Family at their Morning Devotions' (1870), which was purchased by the Leipsic Museum. After a visit to his home in the United States he returned to Munich and painted 'Elaine the Fair' (1874) from Tennyson's idyll

ROSEOLA — ROSES

ot 'Elaine.' He also produced some humorous pictures, such as 'He Laughs Best Who Laughs Last' (two panels); and 'The Girls' Boarding School in Alarm' (1877). His name will be perhaps best remembered for his 'Trial of the Escaped Nun, Constance de Beverley' (from Sir Walter Scott's 'Marmion'); and 'A Dancing Lesson in the Time of the Empire.'

Roseola, any rose-colored rash occurring, usually in a symptomatic character, with some febrile disorder, as measles, scarlet fever, etc., or with gastric disturbances. The term is often applied, though inexact, to German measles and to mild forms of other diseases attended with a rash of similar appearance to that seen in roseola.

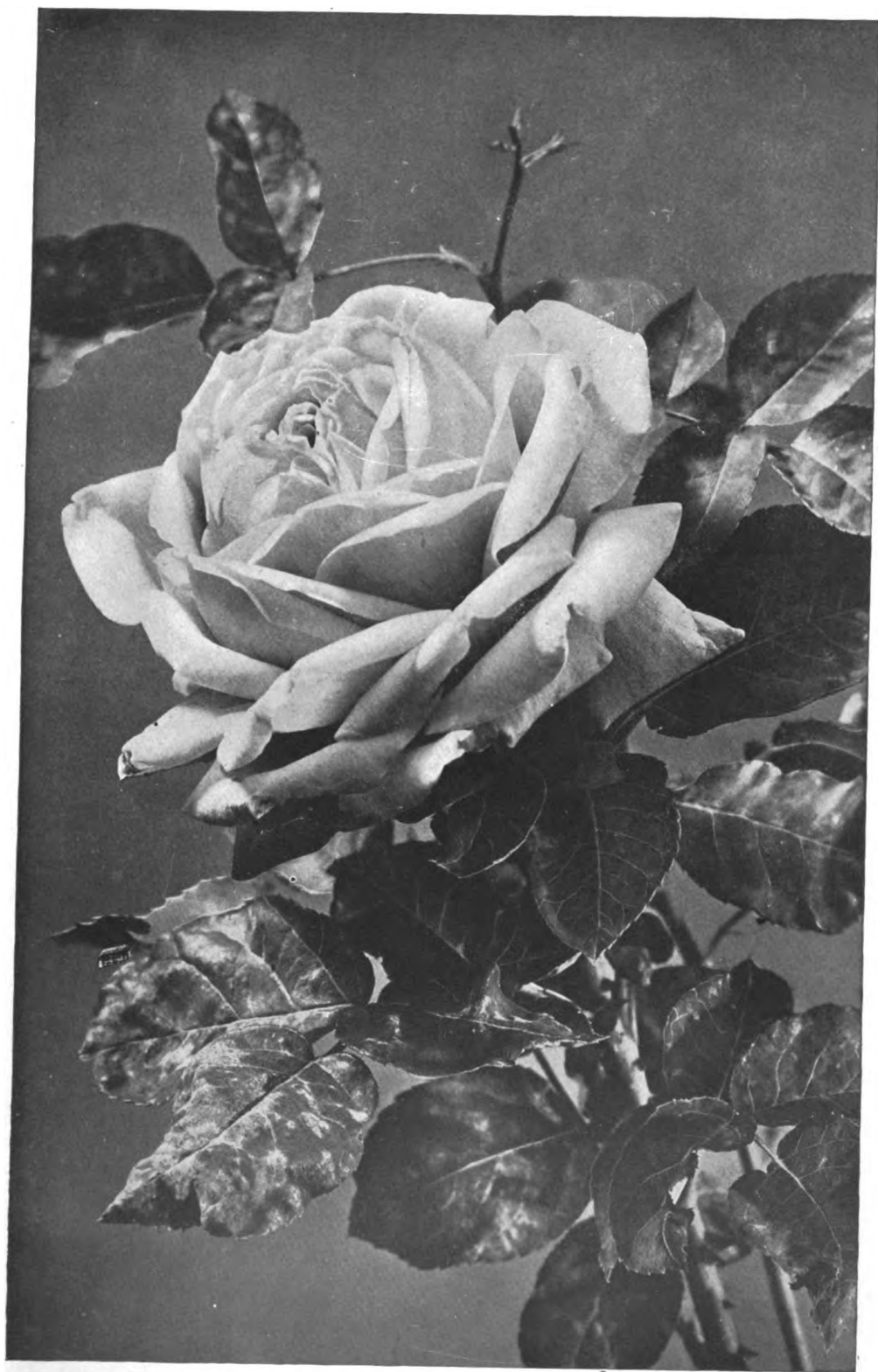
Roses, flowers of the type-genus *Rosa*, of the order *Rosaceæ*. The species are exceedingly variable; probably no other genus calling forth so wide a range of botanical opinion. Most botanists recognize about 100 species; Bentham and Hooker estimate the number at less than 40; but, Gandoger describes more than 4,000 as indigenous to Europe and western Asia. The number of horticultural varieties, crosses and hybrids is probably several times larger than in any other genus; more than 3,000 varieties are listed in French catalogues, and since new ones are added annually the list consists of active members. The roses are widely distributed in the temperate and cold parts of the northern hemisphere extending in the respective continents southward to India, Abyssinia and northern Mexico. They are erect, climbing or trailing shrubs, generally prickly-stemmed; bear alternate, odd-pinnate, though sometimes simple, leaves and generally large, showy, pink, white, yellow or purple flowers borne either singly or in terminal corymbs, followed by generally showy berry-like fruits (hips) which contain several bony akenes. Probably no flower has played so important a rôle in the garden and in literature. It was prized in the cradle days of the Aryan race and is frequently mentioned in the writings prior to our era. China and Japan, however, seem to have been less attracted to it than more western races. In very early times the flowers exhibited their characteristic tendency to double; indeed, it is probably the first flower cultivated in this state, and is now more often thought of in this form perhaps than in its natural single form. The single roses are, however, useful and popular in park planting.

Except for ornamental purposes roses are of small importance; the only uses made of them are the preserving of the fruits of a few species for food and the manufacture of perfumes, especially attar or otto of roses and rose water from the flowers of some other kinds, principally *R. alba* and *R. damascena*, which are extensively grown in southeastern Europe, particularly Bulgaria and adjacent Asia and in southern France, in which last country the leading rose is the Provence, a hybrid variety of *R. centifolia*. The flowers are either put in stills or are macerated. In the distilling process the essential oil is extracted by steam and condensed. In each process there is considerable perfume in the water used and in the maceration process, which is most popular in France, this "rose water" is the product sought rather than the attar which is regarded as a by-product. These

perfumes are among the most important of the world, and it is said that the importations of the attar alone into the United States is greater than the importations of any citrus perfume such as lemon oil, oil of bergamot, etc.

Unquestionably the roses are the most important flowers cultivated. They are prized by every one who cares for flowers at all and throughout the civilized world are probably grown in more gardens than any other flowers. How important they are commercially appears by the statistics quoted in the article *FLORICULTURE* (q.v.). In the United States alone the number of blossoms annually grown for sale has been estimated at 100,000,000, valued at about \$6,000,000. Yet the development of this industry, which now demands the greatest skill of specialists, has sprung from insignificance in 1870; and in 1850 it did not exist.

From the botanist's standpoint the classification of Crépin in his 'Primitiæ Monographiæ Rosarum,' seems to be one of the most satisfactory and is followed by botanists perhaps more frequently than perhaps any other; from the gardener's standpoint Barron in the 'Cyclopedia of American Horticulture,' divides the roses into 19 groups with more or less subdivision. Among these the following are probably the most important. *Provence*, perhaps most familiar in America in one of its types, the fragrant globular flowered moss-roses; *Damask* and *French*, fragrant-flowered, robust growing, hardy prolific roses; *Ayrshire*, very hardy climbing roses with solitary fragrant white to deep crimson flowers; *Briers*, small perishable-flowered garden roses more useful in shrubberies than for cut flowers; *Multiflora*, with large corymbs of rather short lived flowers, and popularly known as ramblers, used largely in wild gardens, though the crimson rambler and its sub-varieties which belong to the polyantha subdivision are used for porch decoration for which they are admirably adapted; *Evergreen*, the foliage continuing very late in autumn; for example, *R. Wichuraiana*, a very popular hardy trailer which grows anywhere; *Hybrid perpetual*, upright growing, though sometimes pendulous, shrubs which bear flowers of all types and colors and embrace the largest number of varieties of any group but so greatly mixed as to preclude separation and definition; *Hybrid teas*, a group of the preceding, the members being the result of crosses with the Chinese tea-scented rose, especially rich in forcing varieties; *China* or *monthly rose*, a perpetual-blooming rose chiefly interesting because of its effect upon other roses by hybridizing through its variety the tea rose; *Musk*, very fragrant light colored rather tender roses best known in their derivatives, and noisettes, which blossom later, are hardier than the type, and will grow in any soil but are little used probably because the blending with the teas seems to have impaired their hardiness; *Polyantha*, perpetual-flowering multiflora climbing varieties bearing small flowers in clusters and especially promising as the parents of a nebulous group of varieties adapted to American requirements; *Perpetual briers*, best known in America by one of its component species *R. rugosa*, a hardy Japanese rose much used in exposed situations for hedges, screens, etc., and useful for hybridizing with many other species.



A LA FRANCE ROSE.

ROSES

Rose species are propagated by seeds which are either sown as soon as the hips are ripe or are stratified in sand until spring. If allowed to become dry they may require two years to germinate, but if treated as above they generally sprout the first spring. Many species may be propagated by means of cuttings of nearly mature wood taken during summer and rooted under glass. Others will grow from mature wood cuttings taken in autumn and rooted in the spring like currants and gooseberries. Layering is generally practised with such species as do not root readily from cuttings; for example, *R. hemispherica* and *R. eglanteria*. Some species such as the cinnamon rose (*R. cinnamomea*), the Carolina rose (*R. carolina*) and the Damask rose (*R. damascena*), may be propagated by suckers, division or by cuttings of the roots which in the last case should be dug in autumn, stored in sand or sphagnum in a frost-proof cellar until spring when they are planted in nursery rows. Grafting and budding are also practised, but are frequently unsatisfactory where regular intelligent attention cannot be given to the removal of the suckers that generally spring from the stock. For greenhouses and for forcing cuttings of semi-mature wood are nearly universally used. They may be taken at any time, rooted with bottom heat in sand, and kept in pots until large enough to be transplanted upon the branches.

In general, roses thrive best upon loamy soils, rich in plant food and humus, well drained but moist, in situations sheltered from the wind but where they will receive the sunlight at least half the day. They do not generally succeed upon very loose or sandy soils, but often do upon heavy clays. They are seldom difficult to transplant with ordinary care, are easy to cultivate and generally simple to prune. The removal of weak and old wood is the most important pruning detail. But care must be taken especially with climbing varieties to preserve the long sturdy shoots, since they are most prolific of blossoms. Indoor roses cultivated for cut flowers are generally pruned so as to have the flowers borne singly at the ends of long stems sometimes, as in the case of American Beauty, exceeding 4 feet in length. But this is a special florist's practice and is dependent not only upon the method of pruning but upon the management of the plants otherwise. In the garden the plants may usually be set about 30 inches apart in beds about four feet wide, the plants of one row being preferably opposite the intervals of the other so as to obtain full light and air. Beds of this width need not be tramped on when the flowers are being gathered. Cultivation consists in keeping the surface loose and open at all times by raking, a rather shallow forking being given each spring. In the autumn a liberal mulch of stable manure should be spread upon the beds and the coarser parts removed in the spring before the annual forking. The removal of all dead, failing or puny shoots should precede the cultural operations. Many gardeners give applications of liquid manure just as the flower buds appear and preferably preceding a shower. When well managed a rose bed should be satisfactory for ten or more years.

A large number of insects feed upon the rose both out of doors and in the greenhouse.

Of those which sometimes prove troublesome in the garden the rose beetle or chafer is perhaps the most annoying, since it feeds upon the petals of the opening flowers, thus ruining them. The only remedy which has been satisfactorily applied is hand picking. Plant lice (see APHIS) and scale insects (q.v.) are often found upon roses, but in the garden are not usually very troublesome. Slugs occasionally skeletonize the leaves by working upon the undersides and several caterpillars, beetles, etc., also live upon the foliage, usually, however, in insufficient numbers to do damage. In the greenhouse some of the above species may appear, but they are usually debarred by correct methods of management, especially as to ventilation, temperature and humidity. The red spider, not an insect but a mite, is sometimes troublesome where the air is allowed to become too dry. Management will also prevent the so-called plant diseases occasionally found in poorly ventilated houses; indeed, attention to the details mentioned is in many leading houses found more expedient and satisfactory than recourse to the so-called remedies for either insects or maladies.

Bibliography.—Buist, 'The Rose Manual' (Philadelphia 1844, etc.); Prince, 'Manual of Roses' (New York 1846); Parsons, 'The Rose' (New York 1847, etc.); Parkman, 'Book of Roses' (Boston 1866); Shaw, 'The Rose' (St. Louis 1882); Ellwanger, 'The Rose' (New York 1882, 2d ed. 1892, New York); Hatton, 'Secrets of Rose Culture' (Huntington, N. Y., 1891); Vergara, 'Bibliografía de la Rosa' (Madrid 1892).

M. G. KAINS,
Crop Expert.

Roses, Wars of the, the name given to the protracted struggle between the houses of Lancaster and York for possession of the English throne, in the second half of the 15th century. The appellation was derived from the badges adopted by the contending parties, a white rose by York and a red rose by Lancaster. The outbreak of the war was brought about by the growing discontent of the people with the evil fortunes of the war against France and the oppressive taxes necessitated by the heavy military expenditures. The imbecile Henry VI. (q.v.) had shown himself quite incapable of the tasks of government and this served to enhance the power of Richard, Duke of York, the representative of the claims of the house which had been driven from the throne in 1399 in the person of Richard II. The Duke of York's great opponent was Margaret, wife of Henry VI., a woman of great strength of character and much ability. The first battle of the war was fought in 1455 at St. Albans and resulted in a victory for the Yorkists whose head became, for the second time, protector of the realm. War broke out again in 1459 and began auspiciously for the Lancastrians. The Duke of York and the Earl of Warwick and Salisbury were compelled to flee the country. In June 1460, they returned, however, and defeated the Lancastrian forces at Northampton and took Henry VI. prisoner. A compromise was effected by which Henry VI. was to retain the crown until his death, when it was to pass to the Duke of York. Queen Margaret, however, would not consent to this wrong to her son, and continued the struggle. At Wakefield 30 Dec. 1460, the Yorkists were defeated and the Duke of York was killed and

ROSETTA — ROSICRUCIANS

soon after the Lancastrians gained a second victory at St. Albans. Edward, Earl of March, the Duke of York's eldest son, joining forces with Warwick succeeded in getting possession of London, which was a fervent supporter of the Yorkist cause, and was elected king, setting out immediately to meet the enemy on whom he inflicted a bloody defeat at Towton (29 March 1461). Henry VI. fled to Scotland and the remnants of Lancastrian resistance were crushed out at Hedgley Moor and Hexam in 1464. A quarrel between Edward IV. and the Earl of Warwick led the latter to embrace the Lancastrian cause. Returning from France with a large force in 1470 he compelled Edward to seek refuge in Holland. Henry VI. was released from captivity and replaced upon the throne. Edward IV., however, returned to England in the early part of 1471 and on 14 April decisively defeated Warwick at Barnet, the "king-maker" himself falling in the fight. On 4 May a Lancastrian force under Queen Margaret was overthrown at Tewkesbury and the young Prince Edward met his death there, most probably by assassination after the battle. Henry VI. died in the Tower a few days later and Edward IV. was securely established on the throne. The last battle in the long conflict was fought in 1485 when Henry of Richmond, representative of the Lancastrian claims, overthrew Richard III. (q.v.) at Bosworth Field and ascended the throne as Henry VII. By his marriage to Elizabeth, the daughter of Edward IV., he united in himself the claims of the rival houses. See ENGLAND, *Civil History*. Consult: Gairdner, 'Lancaster and York' (1886).

Rosetta, rō-zēt'ta (Ar. RESHID), Egypt, a city near the mouth of the Rosetta Canal,—a branch of the Nile,—formerly the medium of communication between Cairo and Alexandria, which gave to Rosetta a commercial importance which it has lost by the opening up of other channels of traffic. From 1798 to 1807 Rosetta was captured in turn by the French, English, and Turks. Pop. 13,500.

Rosetta Stone, a slab of black basalt of ancient Egypt, now in the British Museum, chiefly noted as having furnished the key for the decipherment of the Egyptian hieroglyphics. The stone was discovered in 1799, during the excavation of Fort St. Julien, near Rosetta, Egypt, by M. Boussard, an officer of engineers in the French army of occupation. Three years later the stone was brought to England and deposited in the Museum. The stone was erected in 195 B.C. by the priests of Egypt in honor of Ptolemy Epiphanes and in commemoration of his remission of the dues of the sacerdotal body (q.v.). It bears an inscription duplicated in three languages, in Greek, in hieroglyphics or sacred, in demotic or common characters, and this fact enabled Dr. Thomas Young in 1818 and later, M. Champollion, in 1822, to decipher it in the three languages and thus furnish a key for the reading of the hieroglyphics (q.v.). The Rosetta Stone is 3½ feet long, 2½ feet wide, and nearly a foot thick. See ARCHÆOLOGY; HIEROGLYPHICS.

Rosetta Wood, an East Indian wood, of unknown origin, reddish orange in color, with darker veinings. The wood is close, hard and very beautiful when first cut, but soon becomes darker by exposure. It is used in fine cabinet work, and is imported in logs.

Rosewater, Andrew, American civil and sanitary engineer: b. Bohemia 31 Oct. 1848. After a course of study in the common and high schools of Cleveland, Ohio, he became flagman in the engineer corps of the Union Pacific Railroad, engaging in explorations and surveys in 1864 and later in other engineering positions on the same road. He was assistant city engineer of Omaha, Neb., 1868-70 and city engineer 1870-5. He was in charge of the construction of the Omaha and Northwestern Railroad 1878-80; was resident engineer of the Omaha Water Works Company, 1880-1, and from 1881-7 was city engineer. Between 1887 and '91 he was consulting and designing engineer of sewerage for 25 cities. Since 1897 he has been city engineer of Omaha and president of its board of public works.

Rosewater, Edward, American journalist b. Bukovan, Bohemia, 1841; d. Omaha, Neb., 31 Aug. 1906. Coming to America in 1854, he became a telegraph operator and for two years (1861-3) was in the United States military telegraph corps. In 1863 he went to Omaha, Neb., as manager of the Pacific Telegraph. In 1871 he was elected to the Nebraska Legislature. In 1871 he founded the *Omaha Bee*, and edited it till his death. He was vice-president of the Universal Postal Congress at Washington, 1897, and the original founder of the Omaha Trans-Mississippi Exposition (1898).

Rosicrucians, rō-zī-kroo'shī-anz, a real or imaginary secret society, the alleged existence of which became known unexpectedly at the beginning of the 17th century. Early in that century appeared several books concerning the society, which are now generally ascribed to Johann Valentin Andrea, a Lutheran clergyman, and among which is the 'Fama Fraternitatis R.C.' (1614). This work is the story of a certain holy and reverend Brother Christian Rosenkreuz, a German noble of the 14th century, who, inspired with the lofty ambition of reforming the world, spent a large portion of his days among the Brahmins, and in Jerusalem, Damascus, Egypt, Morocco, Fez, etc., in the pursuit of wisdom. Returning to Germany he founded an order, consisting of but few members, who met in a house erected by himself, and called Sancti Spiritus Domus, where he died at the age of 106. His burial-place was to be kept a secret by all the adepts, but he ordered the words "Post CXX annos patebo" to be inscribed upon one of the doors of the house of the order. To this work was added another, 'Confession of the Society and Brotherhood of the Rosy Cross,' addressed to the learned of Europe. This tract declared that the order had no intention of interfering with the religious or political action of states, but only desired the improvement of mankind by the discovery of the true philosophy. Whether such a society ever existed is still an open question. Many will have us believe that the above treatises were meant by Andrea to satirize in serio-comic style the philosophical follies of the age, having no expectation of them being regarded otherwise than as fiction. The fraternity had fallen out of public attention for a long time, when in the latter half of the 18th century the interest in their organization was revived, especially by the noted impostor Cagliostro, who gave out that he was a Rosicrucian.

Ros'in, or **Resin**, the name given to the resin of coniferous trees employed in a solid state for ordinary purposes. It is obtained from turpentine by distillation. In the process the oil of the turpentine comes over and the rosin remains behind. There are several varieties of rosin, varying in color from the palest amber to nearly black, and from translucent to opaque. It differs somewhat according to the turpentine from which it is derived, this being obtained from numerous species of pine and fir. It is used in the manufacture of sealing-wax, varnish, cement, soap, for soldering, etc. Colophony is a name for the common varieties. See NAVAL STORES.

Rosmini, rös-mē'nē, **Antonio Rosmini-Serbati**, Italian philosopher: b. Roveredo in the Italian Tyrol, 25 March 1797; d. Stresa 1 July 1855. He began the course of studies for the priesthood at Padua in 1817, and was ordained in 1821. He became deeply versed in philosophy, ancient and modern, and revolved in his mind a comprehensive system to serve as a basis for the truths of revelation, while on the practical side he planned an institution for the training of teachers and priests. From 1826 to 1828 he lived mostly in Milan, thought out the rule of his new order, visited Rome, gained the approval of Pius VIII. both for special studies and for the institution of his order, and published his 'New Essay on the Origin of Ideas' (1830).

After a few years of labor at Trent he settled in 1837 at Stresa on the west shore of Lago Maggiore and, surrounded by loving and devoted friends, sent volume after volume to the press. His dream in politics, as expressed in his 'Constitution according to Social Justice' (1848), was a confederation of the states of Italy under the Pope as perpetual president. For a brief period he basked in the papal favor, and was promised by Pius IX. a cardinal's hat; and on the Pope's flight to Gaeta, he followed, but now found the pontiff's mind turned against him and never afterward regained his confidence. His 'Constitution' and 'The Five Wounds of Holy Church' were next prohibited by an irregular meeting of the Congregation of the Index called at Naples. But in 1854 the Congregation of the Index, the Pope presiding, declared Rosmini's writings entirely free from censure, and enjoined perpetual silence on all his accusers. The "Institute of the Brethren of Charity" survived its founder, and among the Rosminian Fathers, who are mostly Italians or Englishmen, are to be found at the present day some of the ablest and most devoted sons of the Roman Church. In England it has foundations at Ratcliffe, Loughborough, Cardiff, Wadhurst, Rugby, and established in 1876 its central house at St. Ethelreda's, Holborn, once the domestic chapel of the palace of the bishops of Ely.

The foundation of Rosmini's philosophy is being considered as the form of the intelligence—an elemental intuition of which is implanted by Nature herself. Intuition gives us ideas, of which we may affirm (1) that they are not nothing; (2) that they are not ourselves; (3) that they have a mode of existence of their own, entirely different from that of real or subsistent things, and independent of the bodily sense. Their two essential characteristics are universality and necessity; for real objects and sensations are always particular, instead of being

universal and generic, and every object which involves no contradiction is necessarily possible. These two characteristics involve two others, infinity and eternity; the origin of the ideas comes from God, for man does not receive them from the things themselves. The one indeterminate and wholly universal idea is that of being or existence; we cannot determine the subsistence of an object until we first have the idea of it, therefore perception involves the idea which is further isolated from all the other elements of the perception by the process of universalization, through which it may be realized an indefinite number of times. When the ideas are all fully or perfectly determined, they are called concrete; when they remain to a certain extent indeterminate, they are abstract. Being is incorporeal, independent of space, spiritual, and therefore incorruptible and immortal. It is independent of time; as being in its essence is always being, and as it would be a contradiction in terms for being to cease to be being, it is eternal. But since it was united to the soul in time, it must have existed before it and be independent of it. And thus we reach an Intelligence anterior to human intelligence—an Eternal Mind. This eternal mind is God's, and therefore God exists, and His existence and the immortality of the soul remain the true foundation of morals. Consult: Tommaseo, 'Antonio Rosmini' (1855); Lockhart, 'Life of Antonio Rosmini' (1866); Werner, 'Rosmini und seine Schule' (1884); and, above all, Thomas Davidson, 'Philosophical System of Rosmini' (1882).

Ross, rös, **Alexander**, British soldier: b. Scotland 1742; d. London 29 Nov. 1827. He entered the British army in 1760, and was made captain in 1775. He served as aide-de-camp to Lord Cornwallis in the war of the American Revolution, and arranged for his surrender at Yorktown. He afterward served with Cornwallis in India, and in 1812 attained the rank of general.

Ross, **Alexander**, Canadian fur trader and author: b. Mairnshire, Scotland, 9 May 1783; d. Manitoba 23 Oct. 1856. He emigrated to Upper Canada in 1805 where he was for some years a teacher. In 1810 he joined the fur-trading expedition of John Jacob Astor and established trading posts in the most isolated regions. He wrote the earliest and most graphic accounts of the Columbia and Oregon country, with the opening up of which he was for years identified. He also had a prominent part in the colonization of Manitoba. Among his works are: 'Adventures of the First Settlers on the Oregon and Columbia Rivers' (1849); 'Fur Hunters of the Far West' (1855); and 'Red River Settlement: Its Rise, Progress and Present State' (1856).

Ross, **Alexander Milton**, Canadian naturalist: b. Belleville, Ontario, 13 Dec. 1832; d. Detroit, Mich., 27 Oct. 1897. At 13 he came to New York, where he became a compositor on the *Evening Post* and a protégé of William Cullen Bryant. In 1851 he began to study medicine, and during the Civil War was a surgeon in the Union army, but rendered his greatest service to the cause as confidential correspondent to Lincoln in Canada. His subsequent life was chiefly devoted to the study of natural history, in the pursuit of which he has added valuable in-

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formation concerning the fauna and flora of Canada. He published: 'Birds of Canada' (1872); 'Butterflies and Moths of Canada' (1873); 'Forest Trees of Canada' (1874); 'Ferns and Wild Flowers of Canada' (1877); 'Mammals, Reptiles and Fresh Water Fishes of Canada' (1878).

Ross, Clinton, American novelist: b. Binghamton, N. Y., 31 July 1861. He was graduated from Yale in 1884, and began his career in newspaper work in New York. He is the author of: 'The Silent Workman' (1886); 'The Speculator' (1888); 'The Adventures of Three Worthies' (1891); 'Improbable Tales' (1892); 'A Trooper of the Empress' (1898); 'Heroes of Our War with Spain' (1898); 'The Tale of Many Gods' (1903); etc.

Ross, George, American patriot: b. New-castle, Del., 1730; d. Lancaster, Pa., July 1779. On his admission to the bar in 1751 he settled in Lancaster, Pa. As a member of the Pennsylvania assembly 1768-70, he drew up the declaration of rights which was presented by the assembly to the proprietary government. He was a member of the Continental Congress from 1774-7, and as such was one of the signers of the Declaration of Independence. In 1779, three months before his death, he was made judge of the admiralty court of Pennsylvania.

Ross, Sir James Clark, English explorer: b. London 15 April 1800; d. Aylesbury, Buckinghamshire, 3 April 1862. He was a nephew of Sir John Ross (q.v.) whom he accompanied on the voyage in search of a northwest passage in 1818. Between 1819 and 1827 he accompanied Captain Parry upon his four Arctic explorations, and was a member of the expedition of his uncle in 1829-33. His discovery of the north magnetic pole in 1831 raised him to the rank of post-captain; but it was in his memorable voyage to the Antarctic Ocean in 1839-43 that he rendered his most valuable contribution to science. He succeeded in reaching lat. 78° 10', and discovered a great ice-bordered continent which he named Victoria Land, and an active volcano which was called Mount Erebus after the discoverer's ship. For these services he was knighted in 1844. In 1848 he was a member of the party which made an unsuccessful attempt to discover the fate of Sir John Franklin. He became rear-admiral in 1851. An account of his Antarctic expedition was published by him in 1847, entitled 'A Voyage of Discovery and Research in the Southern and Antarctic Regions.' Consult: O'Byrne's *Naval Biographical Dictionary*; Markham, 'Fifty Years' Work of the Royal Geographical Society.'

Ross, Janet Anne Gordon, English author: b. London 24 Feb. 1842. She was married to H. J. Ross, a banker of Alexandria, Egypt, in 1860, was for three years Egyptian correspondent of the London *Times*, and since 1867 has lived in Italy. She has published: 'Italian Sketches' (1887); 'Three Generations of Women' (1888); 'Leaves from our Tuscan Kitchen' (1899); 'Florentine Villas' (1901); etc. The two works last named have been reprinted in this country.

Ross, John, American patriot: b. Rosshire, Scotland, 29 Jan. 1726; d. Philadelphia, Pa., March 1800. After a mercantile experience

of 20 years in Perth, he emigrated to America at the beginning of the rebellion of its colonies, and became at once a staunch defender of the cause of independence. In June 1774, as chairman of the meeting of Philadelphia merchants in protest against British importations, he signed the agreement presented to the authorities and otherwise resisted unjust taxation.

Ross, Sir John, English Arctic explorer: b. Balsarroch, Scotland, 24 June 1777; d. London 30 Aug. 1856. He entered the navy at 9 and was promoted lieutenant in 1805. His first Arctic expedition was made in 1818, when, with Lieutenant Parry, he made a voyage in search of a northwest passage to the north pole. His second Arctic voyage was made in 1829 in a small vessel equipped at the expense of Sir Felix Booth, high sheriff of London, which proved inadequate for the purpose. The exploring party was frozen up in the ice for four winters, and was rescued in 1833 by Ross's old ship, the *Isabella*, in Lancaster Sound. He was knighted for his services in 1834, and made rear-admiral in 1851. In 1839 he was appointed consul at Stockholm, and served until 1845.

Ross, John, or **Kooweskoowe**, Indian chief: b. Georgia 1790; d. Washington, D. C., 1 Aug. 1866. He was a Cherokee half-breed who became chief of his tribe in 1828. In 1817-19 Georgia attempted to remove the Cherokees from its borders through a bribe offered to Ross, who had received an English education and was a man of importance in his tribe. He exposed the attempt and continued to repulse the concerted effort of the people of the State to effect their removal. In 1829 Ross, as chieftain, successfully appealed to the Supreme Court of the United States against the action of the Georgia legislature in expelling his people, nevertheless the Cherokees were banished in 1838.

Ross, Jonathan, American jurist and statesman: b. Waterford, Vt., 1826; d. Saint Johnsbury, Vt., 22 Feb. 1905. He entered Dartmouth College in 1847 and was graduated in 1851. He earned his early education by working on his father's farm during the summer, and by teaching school during the winter. After graduating, he taught in Craftsbury, and was principal of the academy at Chelsea, Vt. Meanwhile he studied law, and was admitted to the Orange County bar in 1856, practising until he was elected in 1870 as assistant judge of the Supreme Court. He was elected chief judge in 1890. Judge Ross was State attorney for Caledonia County 1862-3, represented Saint Johnsbury in the legislature 1865-7, and in 1869 was a member of the last council of censors held in the State. In 1870 he represented Caledonia County in the State Senate, was for several years a member of the State board of education, and early in 1899 was appointed by Gov. Smith to succeed Justin S. Morrill in the United States Senate.

Ross, Sir William Charles, English painter: b. London 3 June 1794; d. there 20 Jan. 1860. Entering the schools of the Royal Academy (1808) he carried off five silver medals, during his career as a student, and when he was but 15 (1809) exhibited at the Royal Academy 'Mordecai Rewarded'; 'The Judgment of Solomon'; and the portraits of a mother and child as 'Venus and Cupid.' In 1821 his 'Judgment

of Brutus' gained the gold medal of the Society of Arts. His most ambitious religious picture, 'Christ Casting out the Devils from the Maniacs in the Tombs,' exhibited at the Royal Academy (1825), was the last large canvas that he executed. Henceforth he devoted himself to miniature. He was elected R.A. in 1839 and became the most fashionable painter of his time in his chosen department. He painted Queen Victoria, Prince Albert, and their children, the King and Queen of the Belgians, and was summoned to Lisbon to paint the King and Queen of Portugal. Prince Louis Napoleon, (afterward Napoleon III.) sat for him; and he also painted every personage of his day in England distinguished for rank or genius. The total number of these exquisite works, as calculated from his own memoranda, was 2,200. He wisely attempted to give to the miniature that breadth of treatment which distinguished Reynolds, whom he evidently took for his model. His drawing was invariably correct, and marked by a nameless elegance enhanced by the truthfulness and clearness of his flesh tints and his clever handling of textures. His miniatures are still considered the models of their class in England. He was an enthusiast in his profession and on his death-bed almost his last words were expressions of regret that photography would destroy the art of painting in miniature.

Rosbach, rös'bäh, or **Rosbach**, Prussia, a village of Saxony, in the government of Merseburg, 17 miles south of Halle, famous for the battle fought in its vicinity 5 Nov. 1757, when 22,000 Prussians under Frederick the Great defeated 43,000 French and Imperialist troops commanded by Soubise and the Prince of Saxe-Hildburghausen. The allies' loss was 1,700 killed and 7,000 taken prisoners, while the Prussian loss amounted to only about 500 killed.

Rosse, rös, **William Parsons**, 3D EARL OF, British astronomer: b. York 17 June 1800; d. Monkstown, Ireland, 31 Oct. 1867. He was educated at Dublin University and at Magdalen College, Oxford, where he was graduated in 1822. He was member of Parliament for King's County from 1823 to 1834, and succeeded his father in the earldom in 1841. In 1845 he was elected a representative peer of Ireland, but took little interest in politics. During the stormy discussions on the first reform bill he was occupied with the construction of his first famous reflecting telescope, the speculum of which had a diameter of three feet, and was soon superseded by one of double the size. The two great defects which had hitherto baffled opticians in constructing large reflecting mirrors were spherical aberration and absorption of light by specula, and in the casting of those of large size there arose the apparent impossibility of preventing cracking and warping of the surface on cooling. Even the proper admixture of the metals for the reflector had to be ascertained by numerous and costly experiments. At last, however, a gigantic speculum, weighing three tons, was turned out without warp or flaw and was then polished and mounted on a telescope 52 feet in length in Lord Rosse's park at Parsonstown, at a cost of \$150,000. The sphere of celestial observation was immensely widened by an instrument so powerful; nebulae which had defied Herschel's telescope were resolved into stars, and new nebulous mist was revealed to the observation. The con-

struction of the telescope, effected under the earl's direction and superintendence, is fully described in the 'Philosophical Transactions' of the Royal Society, of which body he was president 1849-54.

Rosselli, rös-sel'lē, **Cosimo**, Italian painter: b. Florence 1439; d. there 1507. He was a pupil of Neri di Bicci, the representative of the early Florentine school, and this school furnished the guiding principles of his artistic life, which was especially influenced also by the work of Benozzo Gozzoli. The altar-pieces and frescoes which he produced were filled with figures dressed in the costumes of his day, and the realistic minuteness of his faces seems to suggest that they were portraits of his contemporaries. He was in short a genuine Pre-Raphaelite of the Florentine school. His finest work is a fresco in the chapel of Sant Ambrogio at Florence: 'The Exhibition of a Miracle-working Chalice,' — a fashionable religious function of old Florence, displaying the silks, laces and jewelry of the time in all their splendor. Among other good works of his may be mentioned: 'The Coronation of the Virgin' and an 'Assumption,' both at Florence. He was called to Rome in 1480 by Sixtus IV. and contributed to the decoration of the Sistine Chapel, with the approval of the Pope who admired his lavish use of gold and ultramarine. Among his pupils the most celebrated were Pietro di Cosimo and Fra Bartolommeo (q.v.). He produced few easel pictures, but one of these, 'The Annunciation' (1486), was sold in 1847 for \$1,627 in England.

Rosser, **Thomas Lafayette**, American soldier and civil engineer: b. Campbell County, Va., 15 Oct. 1836. He entered West Point from the State of Texas in the class of 1861, but when President Lincoln ordered that class into the field after the attack upon Fort Sumter, Rosser resigned and entered the Confederate army, in which he was appointed 1st lieutenant of artillery and later captain. In 1862 he was made lieutenant-colonel and shortly afterward colonel of the 5th Virginia regiment under J. E. B. Stuart. In 1864 he became major-general in the army of Northern Virginia. He refused to surrender at Appomattox; escaped through the Federal lines, and while trying to reorganize scattered troops was captured and made a prisoner of war. After the war he studied law, but did not practice. In 1868 he became assistant-engineer in the construction of the Pittsburg and Connellsville Railroad; engaged on the Northern Pacific in 1870, becoming the next year chief engineer of its construction through Minnesota, Dakota and Montana; in 1881 became chief engineer of the Canadian Pacific railway. In 1886 he returned to Virginia to reside, and in the war with Spain in 1898 commanded a volunteer brigade.

Rossetti, rös-sët'tē, **Christina Georgina**, English poet, daughter of Gabriele Rossetti (q.v.): b. London 5 Dec. 1830; d. there 29 Dec. 1894. She was educated at home and her first verses were written in 1842 and printed in the private press of her grandfather, Gaetano Polidori. She was probably her brother Dante's first model and many portraits of her exist both as portraits and as figures in his paintings. A volume of her verse came from the Polidori press in 1847 and, later, after the establishment of 'The Germ' in 1850, she contributed to it

under the name of "Ellen Alleyne." Of a deeply religious temperament, she was a devoted English Churchwoman and her writing, aside from devotional manuals and strictly religious works, was mainly poetry of a devotional character. 'Goblin Market,' however, published in 1862, is not of this type; and for original and purely imaginative qualities was never afterward approached by her. She also wrote 'The Prince's Progress' (1866); 'A Pageant' (1881); stories and nursery rhymes under the titles, 'Commonplace' (1870), and 'Sing Song' (1872); 'Verses' (1873), and such religious works as 'Annus Domini' (1874); 'Called to be Saints; the Minor Festivals' (1881); 'Time Flies: a Reading Diary' (1885); 'The Face of the Deep' (1882). From 1871 to her death she was for most of the time an invalid. Consult: Mackenzie Bell, 'Christina Rossetti: a biographical and critical study' (1898).

Rossetti, Dante Gabriel, English poet and painter: b. London, 12 May 1828; d. Berchington, 10 April 1882. His full name was Gabriel Charles Dante, but for literary purposes he rearranged it in the form by which he is now remembered. He was one of four children, all of whom, especially himself, his sister Christina and his brother William Michael, achieved fame in literature. His father, Gabriele Rossetti, professor of Italian in King's College, was an Italian exile, an enthusiastic patriot, himself a poet, and author of several critical works on Dante. He had married Frances Mary Lavinia Polidori, of English and Italian blood.

Dante Gabriel was educated at home, in an atmosphere of culture and fine enthusiasms; from his ninth to his fourteenth year he attended King's College. During that time he received some instruction in drawing, and upon leaving college he gave himself to the study of art, entering the Royal Academy in 1848. At the same time he began his translations from Dante and other Italian poets, showing from the first more genius in poetry than in painting. His great poem, perhaps his most remarkable, 'The Blessed Damsel,' was written about 1847. In 1848 he entered the studio of Ford Madox Brown, where he met Woolner, Holman Hunt, and Millais—the group that with himself and Madox Brown constituted the so-called pre-Raphaelite brotherhood. In 1850 William Michael Rossetti edited *The Germ*, a short-lived but famous magazine devoted to pre-Raphaelite ideals; in its name appeared 'The Blessed Damsel' and other work of Dante Gabriel Rossetti's. Just what were the ideals of the pre-Raphaelites is hard to define; they stood in general for the devotional sincerity in art of those painters who preceded Raphael, and for freedom from modern academic canons; yet Rossetti himself was not strictly a pre-Raphaelite; his drawing was quite in his own style, little affected by the manner of the old painters.

For some time Rossetti had to face the proverbial artist's struggle: his pictures were not bought, and the peculiarities of his drawing were severely criticised. Ruskin's kindly defense of the pre-Raphaelites, however, encouraged the whole group. Shortly afterward Ruskin made Rossetti a standing offer to buy, up to a certain sum, all of Rossetti's painting that pleased

him. The arrangement lasted for some time, to Rossetti's great benefit. Through Ruskin he met Sir Edward Burne-Jones, who introduced him to Morris and Swinburne. Ruskin also generously assumed the cost of Rossetti's first volume, the 'Early Italian Poets,' a collection of translations which appeared in 1861. Rossetti afterward paid back the loan, and the book was reprinted in 1874 under the title of 'Dante and His Circle.'

In most of Rossetti's early pictures, his Beatrices and ideal ladies were copied after his wife, Elizabeth Eleanor Siddal, herself a poet and artist, whom he had married in 1860. Mrs. Rossetti was an invalid; the poet had no delusions as to the sadness shortly in store for him. But when, in 1862, his wife accidentally hastened her fate by an overdose of laudanum, Rossetti gave way impetuously to his grief, and in his impulsive despair buried in his wife's coffin the manuscript of his poems, for the most part inspired by her.

In the course of the next seven years—during which time he continued his painting with success, and also began the use of chloral—his friends persuaded him to recover his manuscripts, which he did in 1869. The following year appeared his 'Collected Poems,' containing the 'House of Life' sonnet sequence in its original complete form. In October 1871, Robert Buchanan, under the pen-name of "Thomas Maitland," wrote an essay entitled 'The Fleshly School of Poetry,' in the *Contemporary Review*. The purpose of this article was to show that Rossetti's poetry in thought and expression, was indecent; and to make his point the writer did not shrink from misquoting Rossetti or perverting his meaning. Rossetti made an adequate reply in an article called 'The Stealthy School of Criticism,' and in later editions somewhat unnecessarily withdrew the verses that had most offended Buchanan. But the injustice of the attack preyed upon him until his mind was deranged: at one time only the loving care of his friends prevented him from committing suicide.

He partly recovered his mental poise, and for a time entirely recovered his poetic and artistic faculties, which seemed at first not to be affected by his use of chloral. Several of his best pictures belong to this time; the 'Ballads and Sonnets' were published in 1881. These last years, however, were years of pitiful suffering and gradual collapse. His friends sheltered him from his worst moods and cared for him to the end.

In both painting and poetry Rossetti's personality expressed itself with unusual evenness throughout his career, and in 'The Blessed Damsel,' one of his earliest poems, almost all his qualities can be traced. Like so much of his other writing, it was illustrated, set to painting, as it were, by himself; but without such aid the pictorial genius is strong in the verse. The ideas are typically concrete; not only the Damsel, leaning on the bar of Heaven, is seen, with the lilies in her hand, and on earth the fall of autumn leaves, and in the sky the "curled moon"; but from all points of view the appeal is to the eyes, as in that imaginative glimpse of the world spinning far below the bridge of Heaven; and in the picture of

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souls ascending to God like thin flames—such as William Blake could have drawn; and in that "strong level flight" of the angels. The three lilies in the Damozel's hand and the seven stars in her hair, and the five handmaidens of the Virgin, are definitely numbered for the effect of concreteness; Rossetti habitually employs the device, as Keats employed it in the 'Belle Dame Sans Merci,' after the manner of the old English ballads—a manner that strongly influenced Rossetti. Partly from the ballads 'The Blessed Damozel' derived some of its mediæval flavor; but the quality was really personal with the poet. Here as in his other poems Rossetti manages to reproduce the romance of the archaic, without any great reproduction of the archaic itself. The furnishing of Heaven in the poem is quaint and remote, in effect like the lovely names of the five handmaidens; but the thought or attitude of no particular past time is revived. Perhaps some of this pseudo-archaic flavor comes from the strange verse-music, which Rossetti introduced into English. The secret of much of its charm is veiled in the poet's genius, but its most striking trait, its melancholy evenness, can be explained by Rossetti's training in Italian prosody. In writing English poetry he departs radically from the genius of English metre; instead of fitting the words, with their natural accents undisturbed, into the regular beat of the verse—so placing them that the natural reading of the line would determine the rhythm,—Rossetti allows a preconceived rhythm to determine the accent of the words, as in the line "With her five handmaidens, whose names," etc.

These characteristics of 'The Blessed Damozel,' and others besides, reappear more marked in other poems—the subtlety of thought, in 'Love's Nocturne'; the mediæval mood of devotion, altogether or almost religious, in 'Ave,' and in 'The Portrait,' with its splendid closing image; the ballad element, together with the unusual skill in reproducing physical sensation, in 'Eden Bower,' 'Troy Town,' and the longer ballads; and the same sad, even music in them all. Among his other verse the elaborate ballads—'Rose Mary,' 'The White Ship,' 'The King's Tragedy,' show Rossetti's debt to ballad literature, and at the same time mark the wide gulf between the clear simplicity of the old narratives and the wrought loveliness of his work. In his shorter ballads, however, such as 'Stratton Water,' he is much simpler. What hold he had on real life is powerfully concentrated in 'Jenny,' probably his most thoughtful poem.

Rossetti's sonnet sequence, 'The House of Life,' undoubtedly places him among the masters of the sonnet form, though none of the sonnets, perhaps, are so well known as 'The Blessed Damozel.' Technically, they have more of the rise and fall of the best Italian models than is usual in English poetry, and at times, as in the first sonnet, or the twenty-fourth or the twenty-fifth, their cadence is superb. But in many of them the mystical subject-matter is baffling, and Rossetti's characteristic evenness of manner, here also an evenness of mood, makes the sequence monotonous at last. Perhaps Rossetti's best sonnets were written singly for pictures—as the beautiful 'Lilith,' and the 'Venus Verticordia,' with the three wonderful lines at the end.

The most widely known of Rossetti's trans-

lations are the three from Villon, especially the 'Ballad of Dead Ladies,' and Dante's 'Vita Nuova.' In all of his translated verse, however, the same traits are found as in his original work—the same exquisite, rather than great mood, the same concrete, yet remote, aspects of beauty, and the same un-English music of the verse. He has many imitators in both his arts.

Bibliography.—The best edition is by W. M. Rossetti. For biography and criticism, consult Introduction to the above; 'Dante Gabriel Rossetti; His Family Letters,' with memoir by W. M. Rossetti; Hall Caine, 'Recollections of Dante Gabriel Rossetti'; Walter Pater, in 'Appreciation'; the same essay in Ward's 'English Poets.'

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Rossetti, Gabriele, Italian poet: b. Vasto, Abruzzo Citeriore, 28 Feb. 1783; d. London, England, 26 April 1854. He was educated at the University of Naples and in 1814 was appointed curator in the Museum there. He joined the Liberals and in 1815 became a member of the secret society of the Carbonari. He was a supporter of the constitution which King Ferdinand was forced to grant as the result of a military uprising, and when in 1821 the constitution was abrogated and its adherents proscribed Rossetti was compelled to fly the country. He went first to Malta and in 1824 to London where he was engaged as a teacher of languages and was elected professor of Italian at King's College, London, in 1831. In his political opinions he continued an ardent Liberal, but was in favor rather of a constitutional monarchy than a republic. In religion, though never wholly abjuring the Roman Catholic creed, he was for many years practically a freethinker, though in later years he accepted an undogmatic form of Christianity. In 1845 blindness compelled his resignation from the college. His works include: 'Dante, Commedia' (1826); 'Lo Spirito Antipapale che produsse la Riforma' (1832); 'Poems' (1833); 'Il Mistero dell' Amor Platonico del Medio Evo' (5 vols., 1840); 'La Beatrice Dante' (1842); 'Il Veggente in Solitudine' (1846); 'L'Arpa Evangelica' (1852); etc.

Rossetti, Maria Francesca, English author, daughter of Gabrielle Rossetti (q.v.): b. London, England, 17 Feb. 1827; d. there 24 Nov. 1876. She engaged in teaching and in literary work, the latter being chiefly of an educational or religious character, and in 1874 entered the sisterhood All Saints' Home, London, where she died. Her works include: 'Exercises in Idiomatic Italian' (1867); 'A Shadow of Dante' (1871); 'Letters to My Bible Class' (1872); etc.

Rossetti, William Michael, English poet and art critic, son of Gabrielle Rossetti (q.v.): b. London 25 Sept. 1829. He was educated at King's College, London, and entered the excise office in 1845. From 1869-94 he was assistant secretary to the board of inland revenue, and is at present professional assistant to the same board for estate duty on pictures and drawings. He has published: Blank verse translations of Dante's comedy 'The Hell' (1865); 'Lives of

Famous Poets' (1878); 'Life of Keats' (1887); 'Mémorial de Dante G. Rossetti' (1895); 'Gabriele Rossetti' (translated autobiography 1901); etc., besides much editorial work, including the works of many poets and the 'Rosetti Papers' (1862-70-1903).

Rossi, Francesco de, frān-chēs'kō dā rōs'sē, known as Il Cecco di Salviati, Italian painter: b. Florence about 1510; d. Rome 1563. He was a pupil of Michelangelo and Parmigiano and a painter of history and mythological subjects. Little is known of his life, excepting that he went to France, made enemies by his eccentric conduct and reckless wit, and found little patronage there. He is said by Vasari to have decorated many Italian palaces and there are examples of his work in several of the great European collections, including his 'Charity' in the English National Gallery; and his 'Holy Family' in the Prado Gallery, which show him to be somewhat mannered in execution, but none the less a painter of the Florentine school at its best.

Rossi, Giovanni Battista de', jō-vān'nē bāt-tēs'tā dā, Italian archæologist: b. Rome 23 Feb. 1822; d. there 20 Sept. 1894. He was distinguished for his studies of the inscriptions of the early centuries of the church, and made important discoveries in the catacombs. He was made a member of the Berlin Academy of Sciences and corresponding member of the French Institute. He published: 'Inscriptiones Christianæ Urbis Romæ septimo Sæculo Antiquiores' (1861); 'Roma Sotteranea Christiana' (1864-77).

Rossini, Gioachimo Antonio, jō-ā-kē'mō ān-tō'nē-ō rōs-sē'nē, Italian composer: b. Pesaro 29 Feb. 1792; d. Passy, near Paris, 13 Nov. 1868. He was born of poor parents, and when only 10 was able to support his mother by singing solos in church. He also took the part of Adolfo in Paer's 'Camillo' at the theatre of the Commune—his only appearance as a dramatic singer. He began his musical studies with his parents, but later he studied composition and counterpoint under Tesei and Mattel, both of Bologna. His first opera, 'Demetrio e Polibio,' was composed before his studies under the latter, and even at that stage of his career he had mastered the art of imbuing his music with feeling. His first public appearance as a dramatic composer was at Vienna in 1810, when his opera 'La Cambriale di Matrimonio,' was performed. Successful though it was, it did not contain any definite evidence of power to assert a new school or create a radical change in style. It had been preceded in 1808 by 'Il Pianto d'Armonia per la Morte d'Orfeo,' a cantata, which gained the prize at the Liceo and was performed in public on 8 August of that year. His next composition was 'Didone abbandonata,' a cantata, followed by an opera buffa, 'L'Equivoco stravagante,' which brought him fresh triumphs. Early in 1812 he produced two buffa operas, 'L'Inganno felice' and 'L'occasione fa il Ladro, ossia il Cambia della valigia,' each of which contained several songs full of force and original melody. He attempted one oratorio, 'Ciro in Babilonia,' which unhappily proved a failure. In the autumn of 1812 he wrote a musical two-act comedy 'La Pietra del Paragone,' produced at the Scala with immense success. In the finale occurs the first instance of his employment of

the *crescendo*, for which he became famous later, and which Mosca declared had been borrowed from his own 'Pretendenti delusi.' In 1813 Rossini composed 'Tancredi,' an opera based on Voltaire's drama, full of good situations and patriotic sentiment. Its choruses are rich in martial passages. 'Di tanti palpiti' became popular everywhere, and made Rossini the most famous composer living. During that year he also wrote 'L'Italiana in Algeri,' containing the charming trio 'Papataci' and the patriotic air 'Pensà alla Patria.' During the next two years Rossini wrote eight operas, including the well-known 'Barbiere di Siviglia' and 'Otello,' while in 1817 he produced his celebrated operas 'La Cenerentola,' 'La Gazza ladra' and 'Armida,' but critics still regarded him as a "mere musical figure-maker and a diluter of melody into mere ornament." 'Ermione,' his next opera, has been styled a "system of word-painting." His next notable compositions were 'Adelaide di Borgogna' (or 'Ottone Rè d'Italia,' as it is sometimes called), and another oratorio, 'Mosè in Egitto.' The former was produced during the Carnival of 1818 and was warmly received, and the latter at the San Carlo in Naples. During the summer of 1818 he wrote 'Adina, o il Califfo di Bagdad' for the San Carlo theatre in Lisbon, and 'Ricciardo e Zoraide' for the San Carlo in Naples, an opera full of ornament. His 'La Donna del Lago' seemed to show that Scott's works were becoming popular even in Italy. In this opera and others that followed, such as 'Maometto,' 'Zelmira,' 'Semiramide,' etc., it was plain that Rossini was half a century ahead of his day. His style was changing; his gaiety had disappeared; he was becoming serious. He now visited England, on the invitation of the manager of the King's theatre in London, to write an opera for that house, to be called 'La Figlia dell' Aria,' for which he was to receive about \$1,200. He arrived in London in December 1823, with his wife, Isabella Colbran, a singer, to whom he had been married about two years, and while there was much lionized. He acted as accompanist at numerous soirées, gave several concerts, singing the solos on two occasions in a cantata which he had composed for the occasion under the title 'Homage to Lord Byron,' and in five months had acquired nearly \$35,000. He then undertook the musical direction of the Théâtre Italien in Paris for 18 months at a salary of about \$4,000 a year. He here reproduced some of his operas, for example, 'La Donna del Lago,' 'Semiramide,' 'Zelmira,' etc., and also brought out a new one—'Il Viaggio a Reims, ossia l'Albergo del Giglio d'Oro'—composed for the coronation fêtes of Charles X. The sinecure positions of "Premier Compositeur du Roi" and "Inspecteur Général du Chant en France," were now given him, with an annual income of 20,000 francs, or about \$4,000. He then revised the music of 'Maometto,' brought out under the title 'La Siège de Corinthe,' and also reproduced 'Mosè,' with many improvements and additions, some of the interpolated airs being taken from 'Armida' and 'Ciro in Babilonia.' He next resolved to try his skill at lyric opera, and adapted to the 'Le Comte Ory,' some of his favorite music in the 'Il Viaggio a Reims,' but it is said that the best part of the drinking chorus was borrowed from Beethoven's 8th Symphony. His next opera, commonly re-

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garded as his masterpiece, was 'Guillaume Tell,' which was produced at the Académie on 3 Aug. 1829.

With its completion the prolific career of the composer may be said to have ended, for though he lived nearly 40 years longer, a few songs, his 'Stabat Mater' and the 'Petite Messe Solennelle' are about all he wrote. These 40 years were spent at Bologna and at Passy, where he died.

Determining to revisit Bologna, where his mother had died in 1827 and where his father was still living, he resigned his post, but made an agreement with the government to compose operas for the French stage for the next ten years, and to produce one every two years, receiving 15,000 francs for each. Should this plan not be carried out, he was to receive a pension of 6,000 francs. On account of the abdication of the king of France and the revolution of 1830, he returned in November 1830 to Paris. The new government, however, was not willing to recognize the agreement above mentioned, and for several years he fought his case in the courts, it being eventually decided in his favor. During this time he wrote his 'Stabat Mater.' In 1836 he again left Paris for Bologna, where his father died in 1839. He now wrote a number of songs and choruses, among which may be cited 'Inno popolare,' for the accession of Pius IX. His wife died in October 1845, and two years later he married Olympe Pelissier, whom he had met in Paris. In 1855 he again returned to Paris. His 'Petite Messe Solennelle' was produced on 14 March 1864, and he afterward scored it for a full orchestra, in which form it was given at the Théâtre Italien on 28 Feb. 1869, three months after his death. "Next to the Emperor," writes one of his biographers, "he became the first man in this city of arts and artists."

Rossini's position among the world's greatest composers has been much discussed. His joyous disposition and light-heartedness have been used as arguments against classing him with such profound composers as Mozart and Beethoven, the latter of whom is recorded as having characterized Rossini's work as "degrading the art in general wantonness with a negligence bordering on frivolity." It has been often said that Rossini's melodies are conspicuous for great sweetness and wonderful sensuous attraction, as for instance in the first finale of 'Cenerentola,' or as evidenced by the jolly roguery of the 'Barber of Seville.' This is unquestionably true, and these are the fruits of his special form of genius. They are his natural endowment, and probably if he had at that time tried ever so hard to write in a different vein, he would have failed. His melodies were intended to please the public, for whom he wrote, and they fulfilled their mission to perfection. That he accomplished much for music cannot be gainsaid, and especially for operatic music in Italy.

Rossini devoted his talents very largely to composing operas, and the list of his works contains the titles of between 50 and 60, including a few which he recast. It should be remembered that with few exceptions he, an Italian, wrote for Italians, and therefore gave them that for which they craved. If he overstepped their limitations, they were dissatisfied; as for instance in 'Otello,' where he was actually compelled to modify the tragic termina-

tion in order to save it from being banished from the Italian stage. The Italians wanted nothing very romantic or sentimental, but as long as Rossini filled his operas with buffoonery and comical situations, they met with unqualified success. All this was changed in 'Guillaume Tell,' the music of which manifests a mind filled with deep emotions and a profound appreciation of the romantic. It is as though he had suddenly determined to disarm his critics by proving himself capable of rising to great heights when the occasion demanded. This work has been well described as a great tone-painting of Switzerland, a kind of pastoral symphony in opera form to which the fable of William Tell is only an accessory. The basic characteristics of his previous operas are absent here, and as though transformed by magical power, he suddenly appears no longer as the buoyant artist of old, but as one in whom had been created an innate love of the true and the beautiful. The sensuous gave place to a grand conception of all that was worthy in musical art.

Notwithstanding the immense popularity of Rossini's compositions, there have been pointed out certain peculiar features repeated over and over again which have caused some of his critics to temper their praise. Nor were these peculiarities entirely of Rossini's own creation, some of them having been borrowed from the works of Generali, Velluti, and others. Prominent among them is the use of the crescendo, "which," says one, "appears as regularly and invariably in his overtures and finales as horse-radish with a joint of roast beef." The constant use of triplets is another mannerism which has provoked adverse criticism, while the undue prominence of appoggiaturas (leaning notes), in many cases of longer duration than the harmonic notes to which they are attached, has also been condemned, as well as his practice of closing his periods by modulating them from the major tonic to the minor mood of the lesser third below, or of the great third above the major tonic. A more serious charge made against him was that of plagiarism, it being stated that besides resorting to the national airs of Italy, he availed himself to a great extent of the ideas of Generali, Cimarosa and other Italian composers, as well as of several German composers, such as Haydn, Mozart, Krommer, etc. Thus, while no competent critic has denied that Rossini possessed genius of an extraordinary character, many are inclined to believe that his inventive faculties were confined within quite measured limits.

In spite of all this, there can be no doubt that his compositions form a memorable epoch in the history of musical art. It was he, moreover, who substituted singing for the endless recitatives which had been in vogue, and he also gave the bass voice a leading part, insisting, too, that a singer should sing the notes of the composer without any additions of his own. He also made the chorus an important feature, and fortified the orchestra by adding wind instruments to the strings, which alone had hitherto been used.

It cannot be questioned that wherever his operas appeared, they became firmly established and in many instances almost banished the classic works of the greatest masters who had preceded him. Thus, in Italy, they nearly sup-

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planted the works of Paeiello, Mayer and others, including even Cimarosa. In Germany the national predilection was for graver music, but even there Rossini was, as one of his biographers puts it, "lord of the ascendant." While he rarely, if ever, reached the tragic grandeurs of Gluck, or the intense feeling of Mozart and Weber, his music is never dolorous and heavy, as is the case with some of the best compositions of the German school. Forceful and precise rhythm is another of his principal characteristics, while his scores are notable for their simplicity of outline and primary conception, although his manner of decorating the framework was at times intensely florid. Consult biographies by Beyle-Stendhal (1823, new ed. 1892); Azvedo (1863); Edwards (1869); Zanolini (1875).

Rossiter, rōs'ī-tēr, **Thomas Pritchard**, American artist: b. New Haven, Conn., 29 Sept. 1817; d. Cold Spring, N. Y., 17 May 1871. He early developed a talent for art and secured Jocelyn of New Haven as his instructor. He studied in Rome 1840-6, and on his return opened a studio in New York, where he was elected a National Academician in 1849. He painted historical and religious subjects, and was an admirable colorist.

Rossland, rōs'land, Canada, an incorporated city since 1897, in the West Kootenay District, British Columbia, on the Canadian Pacific and Spokane Falls and Northern railways, near the international boundary-line. It is the receiving and distributing centre for one of the richest gold-mining districts of British Columbia. Silver and copper are also found; and great smelters and reducing works have been erected here and at Trail, about 10 miles distant. The town is well built, and has schools, churches, wholesale and retail stores, banks, and daily and weekly newspapers. Pop. about 7,000.

Rostand, rōs-tān, **Edmond**, French poet and dramatist: b. Marseilles 1 April 1869. He obtained his education at the Marseilles Lycée and the Collège Stanislas of Paris, and in 1891 was admitted to the practice of law. His first book, 'Les Musardises' (1890), a collection of verse, attracted scant notice; nor was 'Pour la Grèce' (1897), a poem which he recited for the benefit of wounded Greeks and Cretans in the Græco-Turkish war, much more successful. As a playwright, however, he at once met favor. His 'Les Romanesques' (1894), and 'Princesse Lointaine' (1895), both in verse, were applauded by public and press. But they were quite outdone by his 'Cyrano de Bergerac' (1897), a five-act drama in verse, which proved to be one of the most conspicuous successes of the modern stage, being presented in Paris 500 times consecutively, with Coquelin in the title-role. It was given also in the United States in English by Richard Mansfield and in French by Coquelin. It employs the historic figure of de Bergerac (q.v.), duelist and author. 'L'Aiglon' (1900), based on the story of the King of Rome, was given in the United States by Sarah Bernhardt, who created the part in Paris, and, in English, by Maude Adams. Rostand was elected to the French Academy 30 May 1901, the youngest "Immortal" ever admitted. His versification is finished and brilliant, his wit keen and polished; and added to these, his work displays a certain enthusiasm and spontaneity. He contributed,

with Stephen Phillips (q.v.), to the much talked of renaissance of the poetic drama. Among English translations are 'Cyrano' by Thomas and Guilenard (1898) and Hall (1898); 'L'Aiglon' by Parker (1900); 'Les Romanesques' by Fleming ('The Fantasticks' 1900) and Hendee ('The Romancers,' 1899).

Rostock, rōs'tōk, Germany, in the grand duchy of Mecklenburg-Schwerin, on the left bank of the Warnow, 80 miles northeast of Lübeck, is one of the most important cities on the Baltic. It consists of three parts: The Old, the New, and the Middle Town. The east or old town bears the impress of an old Hanse town; the Middle Town is the most modern and best-built. The most noteworthy points of interest are: the palace of the grand duke; the town-house, with its seven towers; the church of Saint Mary (1400) and other parochial churches; the university (1419), attended by about 500 students; the house in which Blücher was born, and the one in which Grotius died; schools, hospitals, etc. The fine promenades surrounding the city were formed on the site of the old fortifications. There is an extensive trade in agricultural products and salt, and important fisheries.

Rostopchin, rōs-tōp'ch'īn, or **Rastopchin**, **Feodor Vassilievich**, Count, Russian general: b. Province of Orel, 23 March 1763; d. Moscow 12 Feb. 1826. He entered the Imperial Guards as lieutenant, was highly promoted under Paul I., but afterward dismissed in disgrace. Under Alexander he became governor of Moscow, and exercised an important influence over the campaign of 1812, even if the assertion of the French that the burning of the city was his work should be untrue. He himself denied this charge in his 'Vérité sur l'Incendie de Moscou' (1824). It is certain, however, that he caused his villa near Moscow to be burned, and took measures for the destruction of the magazines in that city. In 1814 he accompanied the Emperor Alexander to the Congress at Vienna. He afterward traveled, and spent several years in literary pursuits in Paris. His works include a number of historical memoirs, comedies, etc., written in French and Russian, and published in 1853. Consult Schnitzler, 'Rostopchine et Koutousoff' (1863); Segur, 'Vie de Comte Rostopchine' (1872).

Rostov, rōs'tōf, or **Rostoff**, Russia, in the government of Ekaterinoslav, picturesquely situated on a prominent summit above the Don, 20 miles from its mouth in the Sea of Azov. It is the oldest town of eastern Russia, a centre of considerable traffic, and some domestic industries, and its annual fair establishes the prices of cotton goods preliminary to the great fair of Nijni-Novgorod. The chief objects of trade are grain, flour, tobacco, drugs, herbs, saddlery, linen manufactures, and enameled sacred pictures. It has ever counted as an important point, from the period when first contended for by Slavs and Finns. After the Mongolian invasion it declined, and was successively plundered by Tartars, Lithuanians and Poles. Electric lighting, street railroads, and telephones are among its modern features. The ancient cathedral (1216) contains precious sacred relics of Christian missionaries and princes. Pop. about 125,000.

ROSTRA—ROTARY STEAM ENGINE

Ros'tra, a name given the platform or stage in the forum in Rome, whence the orators used to harangue the people, so called from the beaks (*rostra*) of the ships taken, in 338 B.C., from the Antiates, with which it was adorned. It was a circular structure raised on arches, with a stand on the top, bordered by a parapet, the access to it being by two flights of steps.

Roswitha, rös'vê-tā, or **Hrotswitha**, hröts'-vê-tā, German poet: b. about 932; d. about 1002. She was of Saxon birth and a nun in the Benedictine convent of Gandersheim, Brunswick; the first German poet and the first dramatist since the Roman period. She wrote sacred legends, a poetical chronicle of the reign of Otto I., and six Latin comedies for performance before the sisterhood. The latter were imitations of Terrence, and without attempting a development of character they displayed rapidity of action and good theatric effect. Her works were first published at Nuremberg in 1501; translations were made by Benedixen in 1850-3. The best edition was published by Barack in 1858. Consult Köpke, 'Hrotsuit von Gandersheim' (1869).

Rosy Finch, one of the large finches of the genus *Leucosticte*, several species of which inhabit the higher parts of the Rocky Mountains and the colder parts of northwestern America, coming southward in winter. Their plumage is suffused with rose-red, brightest in the males, and in the spring they have a loud and pleasant song. The best known species is *L. tephrocotis*, common in Colorado and Utah in winter. Consult Coues, 'Birds of the Northwest' (1874).

Rot, a disease in sheep and other gram-inivorous animals, produced by the hydatids *Fasciola hepatica* and *Distoma lanceolatum*, often living in great numbers in the gall-ducts and bladder of the animal. (See **SHEEP**.) Also the popular name for many fungoid diseases of plants. See **DISEASES OF PLANTS; FUNGI**.

Rota Romana, rō'tā rō-mā'nā, or **Ruota Romana**, signifies an ecclesiastical tribune of the Roman Catholic Church situated at the papal court; from this situation probably comes the name of the tribunal, since the old papal courts were decorated with mosaics in the shape of wheels or *rotae*. The Rota Romana was at one time a body of vast judicial power, having jurisdiction not only over all cases of appeal and all disputes of beneficiary and patrimonial nature, but as well over the more important class of all cases concerning ecclesiastical benefices. These last are no longer within the jurisdiction of the court, its power being diminished of necessity by the political position of the papacy of to-day. But over the first two classes named the court has full jurisdiction, its decree being final, inasmuch as the only appeal permitted is one directly to the Pope.

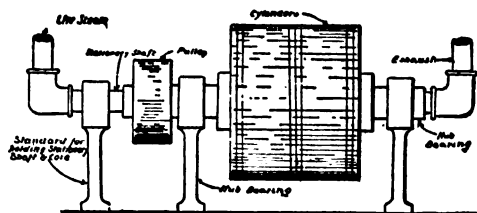
The Rota Romana was, and still is, a collegiate body, although its constitution has undergone radical changes in recent years. Originally it was composed of 12 prelates, mostly Italians, but representing also the other papal states of Catholic Christendom. The meetings which took place in the palace of the Pope twice a week were of supreme importance in the administration of the Roman Catholic Church law throughout the world. The tribuna is now divided into two colleges or senates.

Rotary Steam Engine, a type of engines in which the pistons rotate within the cylinder, or the cylinder upon the pistons, thus giving a continuous rotary motion and eliminating the loss of power consequent to the necessary change in the direction of motion of a piston working horizontally in a cylinder, as in the case of an engine operating with a reciprocating action.

The varieties of rotary engines are numerous, consisting of machines equipped with one, two, three, and four pistons on single axes, or of pistons working in pairs on several axes, operated by steam injected against them, or working by the reactive action of steam emitted tangentially. The basic principle was suggested by the inventors of the last century, among whom Watt, Cartwright, and Galloway may be included; while among the notable engines of this class may be mentioned the Scheutz (Swedish), the Thompson (Scotch), the Behrens (American), and the Pillens and Hill (English), in all of which the pistons revolve within the cylinder, and differ from each other only in the details of the mechanical arrangements employed to utilize the pressure of the steam.

In another form perfected by Harris, portions of the engine are attached to two hubs and run in different directions. The hollow trunnions of one axis carries the two radial arms which emit steam at their ends tangentially against vanes carried on the other axis with a direct driving action. By gearing the two motions are utilized upon a single shaft. The latest development, and perhaps the most efficient, is that perfected by William M. Hoffman, of the type in which the cylinder revolves around the pistons upon an elliptical steam-chest supported by a hollow shaft through which the steam is admitted and exhausted.

Fig. 1 shows a side view of the engine in which A is the revolving cylinder; B, steam entrance to hollow shaft; C, shaft and ellipse support; D, bearings of revolving cylinder; E, steam exhaust from hollow shaft, and F, power connection for gearing or belting.



Standard for holding stationary shaft and core.

Fig. 2 shows a cross section of the cylinder A; the ellipse E, supported by sleeves upon the hollow shaft S; and two segmental blade pistons B and C, which extend the entire length of the cylinder to which they are attached by the cranks G.

By construction the expansion chamber L is formed of three sides—the inner surface of the cylinder, and the outer surface of the ellipse,

ROTATION—ROTATION OF CROPS

both of which are rigid, and the convex surface of the piston B, which is free to move into and out of its housing D.

In operation, the steam is admitted at one end of the hollow shaft S, and exhausted at the

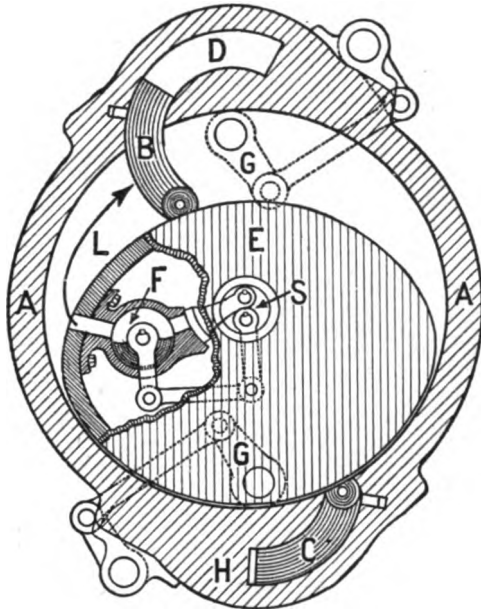


FIG. 2.

other after having been utilized by the action of an automatic cut-off arrangement which allows it to enter the chamber L, through the port F, where it expands and pressing against the piston B, moves it forward over the ellipse, thus causing the cylinder to revolve. As the piston B approaches the greater dimension of the ellipse, it is forced into its housing D, where it forms an abutment against the escape of steam; while the piston C, arrives opposite the port F, exhausts the steam, and relieved of the pressure of the greater dimension of the ellipse emerges from its housing H, into which the free side of a new chamber L, into which the steam is again admitted by the automatic cut-off to expand and continue the action already described.

Rotary engines are designed to obtain the greatest possible efficiency with the least amount of fuel consumption, and a great reduction in engine-room floor space. Engines capable of developing 300 horse-power, at 2,000 revolutions per minute have been successfully and economically operated.

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Rotation, (a) in astronomy, the turning round of a planet on its imaginary axis, like that of a wheel on its axle. The rotation of the earth is performed with a uniform motion from west to east, and occupies the interval in time which would elapse between the departure of a star from a certain point in the sky and its return to the same point. The only motions which interfere with its regularity are the precession of the equinoxes and nutation. The time taken for the rotation of the earth measures

the length of its day. So with the other planets. The sun also rotates as is shown by the movement of spots across its disk (see SUN). The earth's rotation slightly increases the force of gravity in moving from the equator to the poles. Sir William Thomson, reasoning from some small anomalies in the moon's motion, inferred that 10,000,000 years ago the earth rotated one seventh faster than it does now, and that the centrifugal force then was to that now as 64 to 49; (b) in botany, the movement of the protoplasm observed in the cells or cell-walls of certain plants. Little or nothing is definitely known as to the causes that bring it about, but it is probably related to the similar motion in amoeba and other low orders of animal life; (c) in mechanics. See MECHANICS.

Rotation of Crops, the order in which crops are grown during a series of years on the same land. The advantages of this practice are:

(1) All plants tend to exhaust the soil, but in different degrees, hence a rotation tends to maintain a balance. Thus at the Rothamsted Experiment Station, England, where wheat has been grown on the same land for 62 successive years without manure or fertilizers, the average yield is about 13 bushels per acre, or nearly the same as the average yield in the United States, while where grown in a four-course rotation of rutabagas, barley, beans or clover, wheat, the average yield during a period of 52 years is nearly 27 bushels per acre, without manuring or fertilizing. (2) All plants do not take up the same ingredients in the same proportion; thus, crops rich in carbonaceous matter take up relatively small amounts of food from the soil, but large quantities from the air, the latter costing nothing. (3) Some crops give better opportunity for cleaning land, as corn, potatoes. Others cannot be tilled and favor the growth of weeds, as wheat, oats. (4) When several crops are grown on a farm the labor is distributed over a greater portion of the year and it is more economical. The social evils consequent on temporary employment at high wages for a short period of the year, and idleness the rest of the time, cannot be overlooked. (5) Plants vary in their ability to assimilate the plant food in the soil; thus buckwheat and rye are able to flourish where wheat and cabbages could hardly live. (6) The legumes enrich the soil in nitrogen. (7) A variety of crops is essential where cattle and other live stock are kept. (8) In a rotation the increase of destructive insects and diseases is hindered, owing to their not having the necessary crop to prey upon. (9) Some crops permit the sowing of others among them, thus saving time; clover and grass seeds being sown among barley and wheat, wheat sown among corn. (10) Some crops permit the aggregation of the soil particles when they become excessively reduced by tillage, hence land is laid down to grass, alfalfa. (11) Certain crops aid in accumulating humus, as grass, hence such should follow two or three years of exhaustion by tillage. Admitting air to the soil tends to destroy humus and to reduce the water-holding capacity. The loss of humus has converted garden-spots in New York and other Eastern States, northern Africa, Asia Minor, and Spain into wastes, and Sicily, the granary of Italy in the time of the Romans, is now comparatively sterile.

ROTATION OF CROPS

Rotations are described according to the number of years required to complete a circuit, as three-course, four-course, etc. In the latter the tillable land is divided into four parts and each crop is grown on part of the farm each year. The folly of growing the same crop on the same land for several successive years was noted by the Romans and others, as also the benefits derived from growing a leguminous crop, as alfalfa or clover, previous to a grain crop, as wheat. These observations remained unutilized until a comparatively recent date. Rotations have gradually grown into their present forms according to circumstances, and have been and are modified as required and as our knowledge increases. Attention was first drawn to their value in 1777, in a treatise by Dickson of Edinburgh, Scotland.

One of the earliest recorded systems was the "outfield" and "infield," in which part of the land was used for growing grain until its crop-producing power was so reduced that it became unprofitable, when it was allowed to lie idle for a number of years. Increase of population caused a modification, the land being rested or "fallowed" a year at intervals; thus, among the Jews, this was repeated every seventh year. A system of continuous single-cropping has been pursued in the Western States with distinct loss to the nation. Where land is weedy and in dry districts, as parts of California, the east of England, etc., bare fallowing or the cultivation of the soil without growing a crop is still considered good practice, sufficient moisture being conserved to ensure a profitable crop the succeeding year. A development from this system consisted of the introduction of green crops, either intertillage crops, as corn, turnips, potatoes, cabbages, etc., if the land was weedy and needed cleaning, or of legumes, as clover. The advantages of a crop-fallow are that the land is turned to profitable use; it is cleaned and the available nitrogen present as nitrates, is not so liable to be lost by percolation, being taken up by the crops; that humus is produced from the root-residue; and that if a leguminous crop is grown it enriches the soil in nitrogen by means of the bacteria on its roots.

In 1788 Marshall of England stated that a common rotation was: 1st year, wheat, barley, or bigg; 2d year, oats, beans and pulse; 3d year, bare fallow. A distinct advance was made with the realization of the value of the Norfolk four-course, which was practised on light land and originally consisted of roots, barley, clover, wheat. The principles involved are: (1) that a deep-rooted crop shall succeed a shallow-rooted one, barley being shallow-rooted and clover deep-rooted; (2) that crops of the same natural order and somewhat like tendencies, as wheat and barley, both being straw-crops and more or less subject to similar enemies, shall not succeed each other; (3) that a weedy crop shall be followed by a cleaning one, as the roots after the wheat; and (4) that a leguminous crop shall have a place in each rotation. The advantages of this system were: (1) The wheat was grown after a nitrogen-gathering crop; the clover stubble was readily prepared for wheat in the fall, or if stock feed was scarce it could be pastured late and spring wheat or oats grown instead. The wheat was harvested in time to permit the land being fall-plowed and cleaned for

the succeeding root crop. (2) The fallow crop, roots, received manure and intertillage, and gave an opportunity to clean the land and stir it deeply. It furnished work for the horses in summer in cultivating, and a bulky crop of succulent feed for stock, which with the hay furnished considerable manure. (3) A grain-crop follows well after a root crop, and generally little or no plowing is needed. Barley is a good crop to seed with, as it occupies the land but a short time and is not so exacting on the soil moisture as oats. (4) The clover requires a firm seed-bed, and if the roots were consumed on the land and shallow tillage given in fitting the land for the barley such was secured. The barley permitted a good growth of clover which enabled it to withstand the winter. This crop supplied the hay. The disadvantages of this system are that it is too short, the land being liable to become both clover and turnip sick, and the turnips affected with "club-root." Under these circumstances clover and turnips could be taken every eighth year, substituting beans, peas or cowpeas for the former, and potatoes, etc., for the latter. Such close cropping renders the rotation expensive, the labor bill being high, but the cost may be reduced by leaving the grass and clover seeding down for two or three years, thus making a five or six years' rotation, or it may be used as the basis for a 7 or 8 course. This rotation is capable of adaptations as follows: (1) Grain—wheat, oats, barley, rye, corn, buckwheat; (2) Cleaning or fallow crop—corn, potatoes, sugar beets, mangels, tobacco, cabbages, turnips, rutabagas, rape, cowpeas, soy beans, sorghum, etc.; (3) Grain—barley, oats, rye, wheat, corn; (4) Legume—clover, grass and clover, cowpeas, soy beans; (5) Legume—grass and clover, mown once and pastured, or pastured all the year.

In the United States the rotations of crops vary considerably in different sections. In many places the succession of crops is dictated rather by accident or convenience than by any well considered principles. Corn and wheat or oats formed a common two-course rotation with the early settlers, until the land failed to produce a crop of wheat when corn was grown every second year, the land going to weeds in the interval. The "Eastern Shore rotation," which is a two-course, consists of corn followed by oats, with a secondary crop of Magothy Bay beans. The growth of this leguminous crop, while curtailing the yield of oats, furnishes considerable green manure for plowing in. The first system on the best cultivated farms in Virginia was a three-course, beginning with corn, and succeeded by wheat, in which the grass and weeds were allowed to grow and be grazed the third year. One well known farmer in Virginia grew clover in place of the weeds the third year to furnish green manure. A later rotation was: (1) corn or oats; (2) wheat and clover sown; (3) clover grown and plowed under in August, and the land seeded to wheat for the fourth year.

An old and successful rotation recorded for New England is corn, oats, and timothy and clover, the latter remaining down for three years, thus two plowings are required in five years, one for corn, and a light plowing for oats, the grass and clover seed being sown among the oats. A modern three-course rotation for the Eastern States is potatoes,

ROTCH — ROTHSCHILD

winter rye, clover. This is a modification of a well-known Middle Western rotation, potatoes, winter wheat, clover. It embraces a root crop, a cereal and a leguminous crop. It is well suited to light and medium soils and is economical in labor, but one deep plowing being required in three years, that for the potatoes, the land being prepared for the rye by disking. The potatoes are a cash crop, the rye furnishes bedding and feed for stock, and the clover furnishes hay, and is not left down long enough to be seriously injured by the clover-root worm. The rotation is too short for many places, and probably the land would become clover-sick. It may be converted into a four-course by growing a crop of corn after the clover, and into a five-course by sowing grass with the clover and leaving them down for two years, thus corn, potatoes, rye, grass (timothy, redtop, etc., clover), mown, grass mown and grazed. In this way two fifths of the tilled land is plowed each year, that for corn and potatoes; the land for potatoes may be plowed in fall after the rye is sown in September, thus reducing the spring work. If milch cows are kept, the corn furnishes grain and stover or may be cut for silage, the rye may be cut green for fodder or allowed to mature, and the area in potatoes might be reduced and cowpeas, soy beans, peas and barley, or some other fodder or silage crop substituted.

For a dairy farm having half the land in permanent pasture, a satisfactory four-course is (1) corn (cut for silage); (2) oats, the land being fall-plowed, the crop furnishing grain and bedding; (3) wheat (sown in fall, the grain being sold or consumed, the straw used for bedding); (4) clover (sown in spring in the wheat). This rotation permits of carrying the maximum amount of live stock and having a large supply of manure, thus enabling the crop-producing power of the soil to be maintained or increased. The live stock furnish constant employment and enable the farmer to make two profits, that of the grower and the manufacturer.

A common rotation in the Middle West is corn, wheat and clover. The wheat is sown in the corn with a one-horse drill before the latter is mature, the clover being sown in the wheat. Labor is a serious problem and this system economizes it, but one plowing being required.

Consult Wheeler, 'A Rotation of Crops,' Bull. 74, 75, 76, Agr. Exp. Sta., Rhode Island (1900); Gilbert, 'Memoranda of the Rothamsted Experiments' (1901).

SAMUEL FRASER,

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Rotch, rōch, Abbott Laurence, American meteorologist: b. Boston, Mass., 6 Jan. 1861. He was graduated from the Massachusetts Institute of Technology in 1884, and in the following year established and has since maintained at his own expense a meteorological observatory at Milton, Mass. On 14 Dec. 1906 he was appointed professor of meteorology at Harvard University. He was the first meteorologist in the United States to measure the height and velocity of clouds, and to use kites with a self-recording instrument for this purpose. He also made experiments in wireless telegraphy. He has written 'Sounding of the Ocean of Air' (1900).

Rotherham, rōth'er-am, England, town in the West Riding of Yorkshire, at the confluence of the Rother and the Don, five miles northeast of Sheffield. The most notable buildings are the market-hall, post-office, court-house, corporation offices, council hall, and a large number of educational, literary, and benevolent institutions, including a mechanics' institute. The town possesses extensive metal works, potteries, glass works, and rope yards. It is of Roman origin and was of some importance in the Anglo-Saxon period.

Rothermel, rōth'er-mēl, Peter Frederick, American painter: b. Luzerne County, Pa., 8 July 1817; d. near Pottstown, Pa., 15 Aug. 1895. He was educated as a land surveyor, but at 22 studied painting, and about 1840 opened a studio as a portrait painter at Philadelphia, and eventually turned his attention to historical subjects. Among his earlier works are 'Christabel' and 'Katherine and Petruccio.' He has also painted many American subjects, among them 'De Soto Discovering the Mississippi,' 'Columbus Before Isabella the Catholic,' the 'Noche Triste' from Prescott's 'Conquest of Mexico'; 'Patrick Henry Before the Virginia House of Burgesses'; and 'The Battle of Gettysburg.' His pictures reveal a fine sense of color and a power of dramatic composition which are not common; but he has a tendency to exaggeration and his overtrained action is very often less genuinely effective than sensational.

Rothschild, rōths'child (Ger. rōt'shilt). The famous European financial house known as Rothschild was founded by Mayer Anselm Rothschild: b. Frankfort-on-the-Main 1743; d. 19 Sept. 1812. He was of Jewish parentage, and was destined for the priesthood, but found commercial pursuits more to his liking, and engaged in trading, afterward entered a banking house in Hanover. His industry, frugality, and sound business methods made him in a few years the master of a small capital, and he returned to Frankfort, where he established the banking house still in existence. The firm originally consisted of his five sons, who established branches of the house in different European cities: Anselm, b. 12 June 1773; d. 6 Dec. 1855; resided in Frankfort; Solomon, b. 9 Sept. 1774; d. 27 July 1855; lived in Vienna; Nathan, b. 16 Sept. 1777; d. 18 July 1836; located at London; Karl (Baron), b. 24 April 1788; d. 10 March 1855; resided in Naples; and Jacob (Baron), b. 15 May 1792; d. 15 Nov. 1868; resided in Paris. The political events of 1813 raised the house of Rothschild to the important position it has since occupied in the commercial and financial world. In 12 years the Rothschilds raised by way of loan or subsidy an amount exceeding £100,000,000 sterling which was distributed by them in nearly the following proportions: England, £40,000,000; Austria, £10,000,000; Prussia, £8,000,000; France, £16,000,000; Naples, £10,000,000; Russia, £5,000,000; several German courts, £1,000,000; Brazil, £2,000,000; exclusive of various other large sums. The remarkable degree of success attained by the house, setting aside the favorable circumstances of which they have taken advantage, may be largely attributed to their strict adherence to two fundamental maxims laid down by the founder of the house. The first

of these is their conducting all operations in common. Every proposition of magnitude is laid before each member of the firm, fully discussed, and then executed by their united efforts. The second principle is to set definite limits to each operation and never to aim at exorbitant profits. Their wealth has increased in an unexampled degree, and their reputation and credit have been steadily fortified by fair dealing, reasonable terms, and sagacious and systematic operations which are clearly planned and judiciously executed. The Rothschilds are extremely punctual in meeting their contracts, and before the introduction of the telegraph their couriers were frequently in advance of the government. The advantages of their system and their strength were clearly shown when in 1848 they met conjointly a loss of several millions, which would have crushed any other house, but which the enormous scope of their resources enabled them to meet without difficulty. The members of each succeeding generation are admitted into the firm and much intermarriage among cousins indicates that the family is destined long to retain its control of European finance. Lionel Nathan, b. 22 Nov. 1808; d. 3 June 1879, was the first Jew admitted to the English Parliament, and his son Nathaniel Mayer, b. 8 Nov. 1840; d. 13 June 1905, was created a baron in 1885. Since 1815 the Rothschilds have raised for Great Britain \$1,000,000,000; for Austria, \$250,000,000; for Prussia, \$200,000,000; for France, \$400,000,000; for Italy, \$300,000,000; for Russia, \$125,000,000; for Brazil, \$70,000,000; and in 1895 they purchased \$15,000,000 of the United States bonds controlled by the Belmont-Morgan syndicate. Consult: Reeves, 'The Rothschilds' (1887); 'Das Haus Rothschild' (1857); Von Scherb, 'Geschichte des Hauses Rothschild' (1893); Michaud et Villeneuve, 'Histoire de Saint-Simonisme et de la Famille de Rothschild' (1847).

Rotifera, a group of small, usually microscopic animals, are familiarly known as wheel animalcules, because of the presence at the anterior end of a crown of cilia which in their vibration suggest the rotation of a wheel. The opposite (posterior) end of the body is prolonged into a stalk (foot) which is the organ of attachment in sessile forms or is used in walking by such as are free. It is often segmented and may be terminated by one or two pointed toes, while a cement gland in the foot aids in fixation. The anatomy is simple and usually easily studied in the living animal. In general it recalls that of the embryonic annelid with which the rotifers are often genetically connected (see *TROCHELMINTHES*). A vascular system is wanting and the excretory system consists of "flame-cells." The sexes are separate, but the males are rare, degenerate, and needed only for the production of the fertilized winter eggs. Summer eggs develop parthenogenetically. The rotifers are abundant and widely distributed, but confined almost entirely to fresh water. They were among the very first of microscopic organisms to receive attention, and have always been favorite objects of study. A few forms are parasitic in habit and almost all are capable of desiccation and subsequent revival.

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Rotteck, röt'tëk, **Karl Wenceslaus Rotdecker von**, German historian and publicist: b. Freiburg in Baden 18 July 1775; d. there 24 Nov. 1840. He was educated at the University of Freiburg, adopted the profession of advocate, but turned to the study of history, and in 1798 was appointed professor of that department in Freiburg University, a chair exchanged in 1818 for that of natural and international law. In 1819 he was chosen by his university as their representative in the first chamber of the states of Baden, and there proved an ardent champion of political reform. He was one of the founders of 'Der Freisinnige,' a journal with strong democratic leanings, and brought upon himself the displeasure of the conservative party, who compelled him to resign his professorship, and discontinue the editing of all public prints for five years. An ineffectual attempt was made to exclude him from the second chamber of the states, to which he had been elected representative in 1830; but he continued to hold this seat till his death. His chief work is 'Allgemeine Weltgeschichte' (1813-27). Numerous translations of the original work, or an abridgment published by Rotteck, entitled 'Auszug aus der Weltgeschichte,' have appeared in most European languages. It is a critical narrative of prominent events written from a liberal point of view. Other works are: 'Lehrbuch des Vernunftrechts und der Staatswissenschaften' (1829-30); 'Lehrbuch der ökonomischen Politik' (1835); 'Kleinere Schriften' (1829-30); and, with Welcker, a 'Staatslexikon' (1834-44).

Rot'tenstone, a decomposed mineral substance, consisting chiefly of alumina with about one ninth of carbon and half as much of silica. It is supposed to be formed almost wholly by decomposition of shale, and is chiefly found in Derbyshire, England, in South Wales, and near Albany, N. Y. It is either grayish, blackish, or reddish-brown in color, is soft and easily scraped to powder, and is much used for cleaning and polishing metallic surfaces, glass, etc. The term rottenstone is now used to include the tripoli of commerce (first imported from Tripoli, Africa), and also any kind of silicious material suitable for the same purposes.

Rotterdam, röt'ër-däm (Dutch, röt-tër-däm'), Netherlands, one of the chief cities and busiest ports of the country, 36 miles by rail southwest of Amsterdam. Important waterways connect the town with the sea and with the interior. Thus vessels of deep draft may approach quite near, and the amount of tonnage entering Rotterdam (including that which is connected with the inland traffic), is only surpassed by London among European ports. The Hoog Straat, built on the protecting dike, divides the city into Binnenstad and Binstenstad. The intersecting canals cut the Binstenstad into islands. The canals or "havens" are Rotterdam's streets, generally speaking, and the principal buildings line the main "havens." In the Groote Markt is a statue to Erasmus, who was a native of Rotterdam. Saint Lawrence Church, founded in 1414, contains an excellent organ and some fine marble monuments to celebrities. There are churches of all denominations, government offices, academy of fine arts, various museums, several hospitals, and good schools. There are also zoological gardens and a public park.

The modern public buildings form a remarkable contrast to the quaint old-time wooden gabled houses. Rotterdam carries on an active foreign and domestic trade with her colonies, Europe and America. The imports include native produce from her eastern and western colonies, and grain, coal, oil, seeds, etc. The exports are linen, flax, dairy products, gin, and manufactures. Rotterdam boasts many flourishing mills and other industrial works. Pop. about 338,000.

Rotti, röt'tē, **Rottee**, or **Rotto**, an island belonging to the Netherlands, in the Indian Ocean, northwest of Australia and southwest of Timor Island. It is of volcanic origin; its greatest length is 36 miles, and greatest width 11 miles. It has a bold, rocky coast; the surface of the interior is undulating and the soil is very fertile. The lontar, or palmyra palm, furnishes a juice which is one of the principal articles of food. Maize, rice, millet, cotton, and tropical fruits are plentiful, and cabinet woods are exported. Horses, goats, sheep, pigs, and buffaloes abound. Edible birds' nests and wax are also exported. The natives, supposed to have come originally from Java, are a fine looking race. Pop. about 70,000.

Rottmann, röt'män, **Carl**, German painter: b. Handschuchshelm near Heidelberg 11 Jan. 1798; d. Munich 6 July 1850. He early established himself at Munich, but finding little congeniality in the studies of the academy, interested himself in the natural scenery of the country, which formed the environs of the city, and by his independent studies he actually instituted a new school of German landscape. His masterly pictures attracted the attention of King Louis, who engaged him to paint a series of Italian landscapes; and his frescoes, executed between 1829 and 1833 in the arcades of the palace gardens, are remarkable for color and masterly power in line. Among his oil paintings may be mentioned: 'The Acropolis of Sicily' and his 'View of Corfu,' now at Munich in the new picture gallery; 'The Fountain of Callirrhoe,' at Munich; 'Perugia,' in the National Gallery at Berlin. While he was a powerful and imaginative painter in oil, his chief claims to recognition in modern art history are his mastery of water colors and his skill in genuine naturalism.

Roubaix, roo-bā, France, in the department of Nord, six miles northeast of Lille, is a prosperous manufacturing town, containing many mills and factories, dye works, and tanneries. Its public buildings are unimportant. Its woolen and linen manufactures and its carpets are celebrated.

Rouillac, roo-bē-yāk, **Louis François**, French sculptor: b. Lyons about 1695; d. London 11 Jan. 1762. He settled in England about 1720, and a monument designed by him for the Duke of Argyle in Westminster Abbey brought him into great repute. Among his monumental works are statues of Bishop Hough in Worcester Cathedral; of Sir Peter Warren; of Handel in Westminster Abbey; of Shakespeare in the British Museum; and of Sir Isaac Newton at Cambridge.

Rouen, roo-ñ, France, chief town of the department of Seine-Inférieure, situated on the

right bank of the Seine, 87 miles southwest of Paris, ranks next to Lyons as a manufacturing city, and is one of the most attractive provincial towns of the republic. Rouen possesses much interest in its public buildings, many of which are almost perfect specimens of Gothic architecture. They include the venerable cathedral of Notre Dame, the product of centuries of construction; begun in 1220 under Philippe Auguste, it has seen many vicissitudes, but its imposing façade surmounted by lofty towers, its richly decorated walls, its exquisite wood carvings, fine sculpture, and beautiful rose-windows, render Notre Dame one of the most remarkable and artistic of Christian temples. The abbey and church of Saint Ouen also in the Gothic style, whose aerial tower terminates in a crown of fleurs-de-lis; the Church of Saint Maclou, a fine specimen of florid Gothic; the Tour de la Grosse-Horloge; the Palais de Justice, of the 15th century, remarkable for the delicacy and boldness of construction; the Hotel de Bourgtheroulde (15th century), with fine reliefs; the archiepiscopal palace; the musée or picture gallery, containing a fine collection of paintings by French masters; and the ancient Halles or market buildings. There is a large library and several museums of scientific collections. In the Place de la Pucelle Joan d'Arc was burnt. Rouen is the birthplace of Corneille, Fontenelle, Boieldieu, and Flaubert. It is the see of an archbishop, and seat of law courts, and possesses a chamber of commerce, an exchange, mint, and schools of science, art, and the higher professions. The staple manufacture is cottons, in every form, one class of which is so specialized as to be known as *rouenneries*. Besides woolen goods, machinery, chemicals, etc., there are numerous industrial works for weaving, refining, and smelting. The location of the city favors trade. The main articles are corn, flour, wool, cotton, coal, petroleum, wine, brandy, colonial produce, and manufactured goods. Rouen was built before the conquest of Gaul by the Romans. It was captured and pillaged by the Normans in the 9th century. Then it was long held by the English until 1449. Pop. about 120,000.

Rough and Ready, a popular nickname applied to President Zachary Taylor during the Mexican War.

Rough-leg, a buzzard-hawk of the genus *Archibuteo*, especially *A. lagopus*, so called because feathered down to the toes. It is known throughout the northern regions of both continents, and is typically whitish, streaked with rust-red; but the American form best known is a melanotic variety (*A. lagopus sancti-johannis*), which frequents the maritime districts of the Atlantic coast, and is less often seen in the interior, except northerly. The western United States and Pacific coast have a second species (*A. ferrugineus*), called in California squirrel-hawk, which is rusty brown, marked with gray, white, and black; or sometimes plain dark chocolate brown. These hawks are large (23 to 24 inches in length), and of fierce and noble appearance; but they have none of the dash and spirit of the falcons, and indeed seem inferior to the buteos in this respect. Their quarry, though diversified, is always humble: they prey upon various field-mice and other very small quadru

ROUGH RIDERS — ROUGON-MACQUART

ped, lizards, and frogs, and even insects, rarely attacking birds of any kind, and then only the most defenseless. Open fields, especially in the vicinity of water, are their favorite resorts. They appear heavy and indisposed to active exertion; flying slowly and heavily, and often remaining long motionless on their perch. They show some analogy to the owls in points of structure, as well as in their partially nocturnal habits. Wilson observes that it habitually courses over the meadows long after the sun has set, and Audubon calls it the most nocturnal of our species. The nest is ordinarily built of sticks, etc., in a high tree; sometimes, however, on cliffs. The eggs, three or four in number, measure about $2\frac{1}{3}$ by $1\frac{3}{4}$ inches, largely blotched with different shades of brown, sometimes mixed with purplish slate markings.

Rough Riders, a name borne by the 1st Regiment of United States cavalry and also by the 2d United States volunteer cavalry in the Spanish-American War. The original Rough Riders were the men who carried messages through the Western States before the organization of the pony express in 1859, and the name was used by William F. Cody in his "Wild West" show, which contained a "Congress of the Rough Riders of the World." The army regiments were thus named because of the great number of western ranchmen in their ranks, and played a prominent part in the Spanish-American War. The first regiment was organized by Leonard Wood, who was commissioned colonel, and Theodore Roosevelt became lieutenant-colonel. Before the disbanding of the regiment in 1898 a Rough Riders' Association was formed, to which all members of the regiment are eligible, the right of membership to descend to the eldest son. See ROOSEVELT, THEODORE, and WOOD, LEONARD.

Rough-winged Swallow, a small blackish migratory swallow (*Stelgidopteryx serripennis*) of the United States generally, where it nests in summer in holes in banks, in crevices of rocks, etc., and has the general habits of the bank swallow (q.v.). The genus, of which several other species are known in Central and South America, is peculiar in having the outer web of the first wing-quill converted into a series of stiff recurved hooks, which may be supposed useful in creeping into their holes and in clinging to vertical or overhanging surfaces. Considering the general likeness of the bird otherwise to the bank swallow, the fact that this species often makes its nest and lays its pure white eggs in some cranny about a bridge or building is noteworthy. Consult Coues, 'Birds of the Colorado Valley' (1878).

Rouge, roozh, a cosmetic prepared and used to impart artificial bloom to the cheeks or lips. It is applied by means of a camel's hair pencil, puff-powder, or a hare's foot. When rouge is properly prepared, it is said that its application does not injure the skin. Jeweler's rouge is an impalpable preparation of oxide of iron, obtained by heating the yellow oxalate of iron till it decomposes, carbonic acid escaping, and only a red powder being left. It is used for polishing silver, and for this purpose should be of the finest quality.

Rouge et Noir, roozh ā nwör, or **Trente et Quarante**, trönt ā kā-ränt, a modern game

of chance played with the cards belonging to six complete packs. The punters or players stake upon any of the four chances: *rouge*, *noir*, *coulour*, and *inverse*. The banker then deals a row of cards for *noir*, until the exposed pips number between 30 and 40 (court-cards count 10, aces 1), and a similar row for *rouge*. That row wins which most nearly approaches the number 31, and players staking on the winning color receive their stake doubled. *Coulour* wins if the first card turned up in the deal is of the winning color; in the contrary case *inverse* wins. When the number of pips in both rows are equal it is a *refait*, and a fresh deal is made; but if both happen to count exactly 31 it is a *refait de trente-et-un*, and the banker claims one half of all stakes. This last condition places the banker at an advantage calculated to be equal to about $1\frac{1}{4}$ per cent on all sums staked.

Rouget, Georges, zhörzh roo-zhā, French painter: b. Paris 2 May 1784; d. there 9 April 1869. He studied at the Ecole des Beaux Arts, and later under David, who employed him to finish many of his pictures. He became in consequence an imitator of that master. He painted a large number of portraits, those of Louis XVIII. and of Charles X. being noteworthy, and historical subjects. Of the latter are: 'French Princes Paying Homage at the Cradle of the King of Rome' (1812); 'Death of St. Louis' (1817), at Versailles; 'Œdipus and Antigone' (1819), at Rouen; 'Francis I. Pardoning Rebels of La Rochelle' (1822); 'Marriage of Napoleon and Marie Louise' (1837); 'Napoleon Receiving the Decree of the Senate Proclaiming Him Emperor' (1838); 'Death of Napoleon' (1846). Several of the churches of Paris contain religious subjects painted by him; but the major part of his work may be seen at the Versailles Museum.

Rouget de Lisle, roo-zhā dē lēl, **Claude Joseph**, French song-writer: b. Lons-le-Saulnier, France, 10 May 1760; d. Choisy-le-Roi 27 June 1836. He published 'Fifty French Songs, Words of Various Authors, Set to Music by Rouget de Lisle' (1826); etc., but is chiefly remembered as the author of both the words and music of 'The Marseillaise' (q.v.).

Rougon-Macquart, roo-gôn mā-kār, **Les**, a series of 20 novels by Emile Zola, relating the history of a family under the Second Empire and published 1871-93. The novels were intended to form a scientific study of heredity as well as a photograph of French social life. The series begins with 'La Fortune des Rougons' (1871), and this was followed by 'La Curée' (Rush for the Spoil: 1872); a study of the financial world of Paris at the time Haussmann laid out the boulevards; 'La Conquête des Plassans' (1874); 'Le Ventre de Paris' (The Markets of Paris; or Fat and Thin: 1875); 'La Faute de l'Abbé Mouret' (1875); 'Son Excellence Eugène Rougon' (1876), a story of political life; 'L'Assomoir' (Drink: 1877), a story of life among the workmen of Paris; 'Une Page d'Amour' (1878), a physical and psychological study of the various phases of a woman's passion; 'Nana' (1880), a study of the life of a courtesan and actress; 'Pot-Bouille' (1882), a study of the life of the bourgeoisie; 'Au Bonheur des Dames' (The Ladies' Paradise: 1883), a study of the mammoth de-

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partment stores; 'La Joie de Vivre' (1884); 'Germinal' (Master and Man: 1885), a study of life in the mines; 'L'Œuvre' (1886), a study of artist life; 'La Terre' (1888), a study of peasant life and the greed for land; 'Le Rêve' (1888); 'Le Bête Humaine' (1890), a study of railway life; 'L'Argent' (1891), a study of stock speculation; 'La Débâcle' (The Downfall: 1892), a study of the Franco-Prussian war and the Siege of Paris; 'Le Docteur Pascal' (1892). In this last story Pascal Rougon collects all the data relating to his family, and sums up their history.

Rouher, Eugène, è-zhân roo-är, French statesman: b. Riom 30 Nov. 1814; d. Paris 3 Feb. 1884. He studied law and practised his profession in Riom until his election to the Legislative Assembly in 1849. He became a confidant of Napoleon III. and was appointed minister of justice. In 1863 he was made minister of state, and in 1870 became president of the Senate and chief of the Napoleonic cabinet. In 1860 the famous treaty with England was effected largely through his instrumentality in which the free trade policy of Napoleon was inaugurated. His activity in state affairs continued until the fall of the empire when he fled from France. In 1872 he returned as the Corsican representative in the Assembly, and remained in office until 1875. He was to the last the leader of the Bonapartists.

Roulers, roo-lâ (Flem. *Kousselaere*), Belgium, on the Mandel, 17 miles south of Bruges, carries on an active industry in the manufacture of textiles, and a trade in linen, chicory, etc. Pop. about 25,000.

Roulette, roo-lêt, a French game of chance, in which a small ivory ball is thrown off by a revolving disk into one of 37 or 38 compartments surrounding it, and numbered from 1 to 36, with one or two zeros. Players who have staked upon the number of the compartment into which the ball falls receive 36 times their stake; less if they have staked upon more than one number. There are also other chances on which stakes may be placed.

Roumania, a variant spelling of RUMANIA (q.v.).

Roumanille, roo-mä-nêl-è, **Joseph**, modern Provençal poet: b. Saint-Remy, near Avignon, 1818. He was the first French poet to conceive the idea of reviving, as a literary tongue, the local dialects of southeastern France. Accordingly he gathered round him an enthusiastic band of friends, and with their assistance collected materials for a grammar and lexicon and also founded a consistent system of orthography. It was in his programme to produce, and favor the production of, genuine poetry, such as would speak to the hearts of the peasantry to whom this dialect was vernacular. In 1852 he edited a collection of Provençal poems by several authors under the title 'Li Provençalo.' It was mainly under his inspiration that the society of the 'Felibres' was formed, and he was the second president of its consistory.

Round, William Marshall Fitts, American journalist and reformer: b. Pawtucket, R. I., 26 March 1845; d. Achusnet, Mass., 2 Jan. 1906. He was educated at Harvard, became a journalist

and engaged actively in prison reform. He had served as United States delegate to various European prison congresses, was director and corresponding secretary of the National Prison Association, which he reorganized, and he also organized the Burnham Industrial Farm at Canaan, N. Y. He was the originator of the 'Mill' system of awards, now used in many institutions both at home and abroad, and was editor of 'Lend-a-Hand Record.' He wrote 'Achsa' (1877); 'Child Marian Abroad' (1880), 'Rosecraft' (1884); 'Torn and Mended' (1885).

Round, a short, simple musical composition, written generally for three or more voices on the same clef. Each voice takes up the melody after the first has sung the first phrase or so, the third following the second, as it followed the first, and so on, until after a certain number of repetitions the signal is given to stop. It is evident that the melody must be so constructed that each phrase must harmonize with the other, so that, when all the voices are singing, a three- or four-part harmony is heard.

Round Robin, a written protest or remonstrance, signed in a circular form by several persons, so that no name shall be obliged to head the list. This method of bringing grievances to the notice of superiors was first used by French officers, whence its derivation from *rond ruban*, "round ribbon."

Round Table, The. See ARTHURIAN LEGENDS.

Round Towers. See TOWERS.

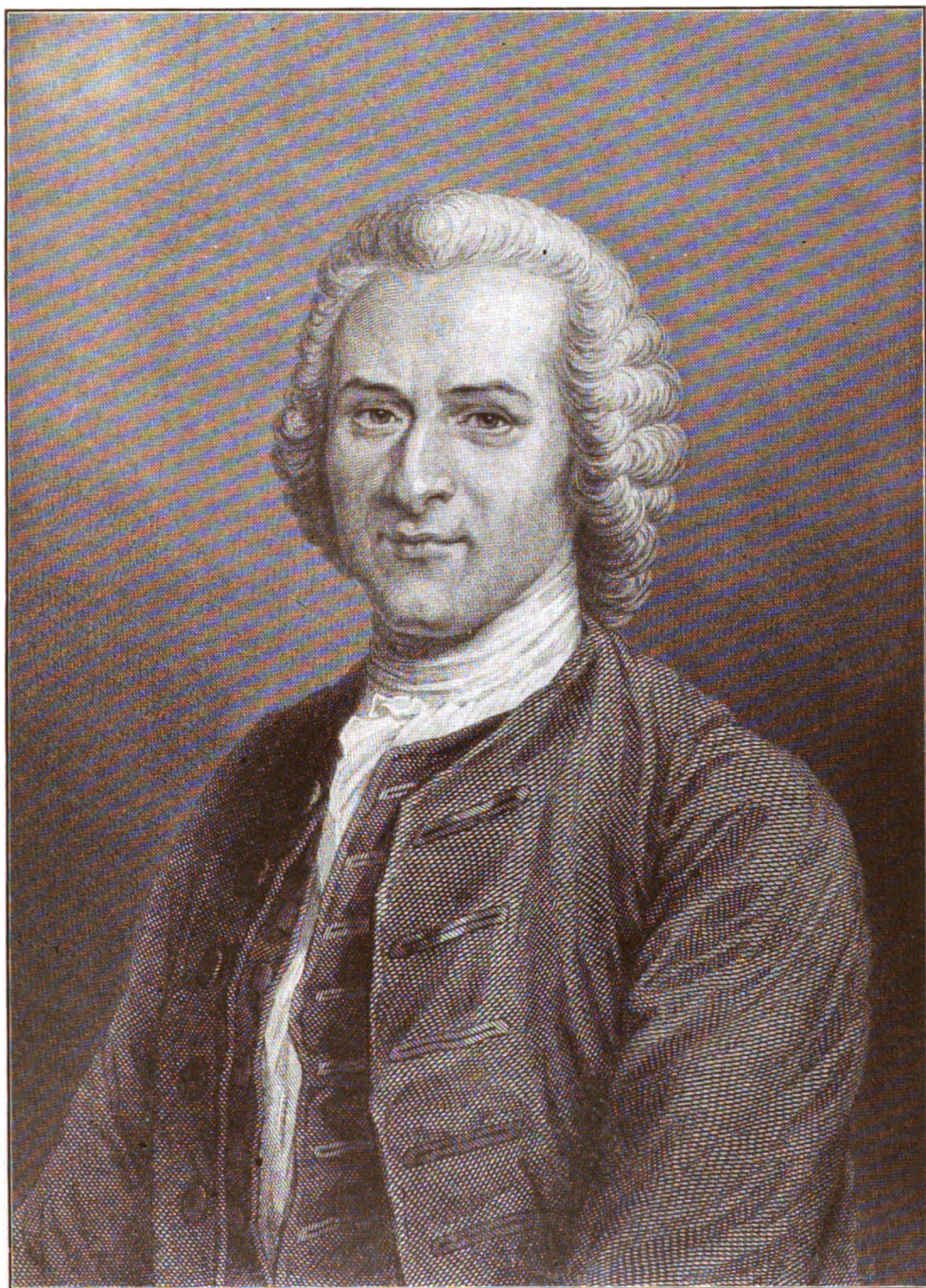
Round'about Papers, The, the title of a work by William Makepeace Thackeray. He became editor of the 'Cornhill Magazine' in 1859 and 'The Roundabout Papers' were sketches for this periodical. They appeared simultaneously, between 1859 and 1863, with 'Lovel the Widower' and 'The Adventures of Philip,' and represent the author's best qualities as an essayist.

Roun'delay. (1) A song of any sort in which a line, refrain, or idea is constantly repeated. (2) The tune of such a song. (3) A dance in a circle. (4) Specifically, a fixed verse-form, originating in France, and better known as the *rondeau* (q.v.).

Rounders, a game played with a bat and a ball by two parties or sides, on a piece of ground marked off into a square or circle or pentagon, with a batter's station, and three (or more) goals or bases at equal distances. On the ball being thrown toward him the batter tries to drive it away as far as he can and run completely round the goals, or over any one of the four parts, before the ball can be thrown back to the batting station. The batter is declared out if he fails to secure a run after having had three balls, if a fielder returns the ball so as to strike him while running, or if the ball from his bat is caught in the air by one of the fielders. See BASEBALL.

Roundfish. See WHITEFISH.

Roundworms, or Thread-worms, worms of the phylum *Nemathelminthes* (q.v.), so called because of their elongated and cylindrical form. They are separable into three classes: (1)



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Nematoda, or roundworms, strictly speaking; (2) *Acanthocephala*, the hook-headed or spiny-headed worms; and (3) *Chaetognatha*, the arrowworms,—a small class of obscure pelagic organisms. The most celebrated of the nematodes is the common roundworm (*Ascaris lumbricoides*), which infests the human intestines, especially in the case of children, who are said to "have worms." These parasites look like earthworms, are 5 to 15 inches long in the grown female, and a quarter of an inch thick, yellowish, with a dorsal and ventral white line, and two brown lateral lines. The three-lobed mouth is terminal at the anterior end, and the anus near the pointed "tail," which varies in form with the sexes. The organization is complicated, and the sexes are always separate, and the males always the smaller. The eggs are produced at the rate of several thousands a day. After fertilization they are enclosed in a tough shell, and are voided by the host with the feces. How the worm gains access to the human intestine is not precisely known. "It is possible," say Parker and Haswell, "that the eggs containing developing embryos, or the embryos themselves, after liberation from the egg-shell, may be taken in by drinking, without previous filtering, water into which fecal matter has been discharged. On the other hand it is quite possible that there may be an intermediate host, such as . . . occurs in several members of the class." Aside from occasional inflammations of the intestine, and obstruction of the bowel from their clumping, they cause no great harm, and various medicines, called vermifuges, expel them. Other species inhabit the intestines of the pig, the horse, the frog, etc. The last named (*A. nigrovenosa*) is remarkable in being hermaphroditic, and for its life-cycle. It begins by the worm entering from the water the mouth of a frog and making its way into the lungs, where it resides long enough in a hermaphroditic condition to produce eggs. These hatch and the embryos cut their way through to the enteric canal, where they escape with the feces. Then they develop into a mature form (*rhabditis*) in which the sexes are separate; in this the fertilized eggs develop in the body of the female, and when fully formed make their way through the walls of the uterus and proceed to devour the whole substance of the mother, leaving only the cuticle. Gaining their freedom they exist in the mud until taken into some frog's mouth, and a new cycle is begun. This is the form of alternate generations called heterogeny—the alternation of a hermaphroditic with a dioecious form.

Closely related to this are various parasitic nematodes, of which one is the thread-worm (*Oxyuris vermicularis*), or "pin-worm," which infests the rectum or lower bowel of children particularly, and gives rise to distressing symptoms, chief of which is an intolerable itching. Its length averages a quarter of an inch; and occasionally inflammation results from their presence in large numbers.

The eel-worms (*Gordius*), guinea-worms, vinegar-eels and similar more or less dreadful parasites also belong here, the worst of which, perhaps, is the trichina.

The class *Acanthocephala*, or spiny-headed

worms, includes a few genera of parasitic worms of which *Echinorhynchus* is chief. Most are minute, but *E. gigas*, affecting the pig, may be 12 to 18 inches long; few other cases of their affecting mammals are known, the majority of species infesting inferior animals. These worms have at the head a protrusile proboscis, covered with rings of recurved hooks, which is buried in the wall of the intestine of the host, enabling the worm to hold its place. The development is complicated. The embryos escape from the intestines of the host, and die unless they are swallowed by some creature suitable for the development, such as certain shrimps for the fish-parasites, and a beetle for *E. gigas* of the pig. Should this "intermediate host" be eaten by the fish or the pig the developing worm fixes itself in the intestine and matures. See EEL-WORM; FILARIASIS; GUINEA-WORM; PARASITISM; TRICHINOSIS. Consult: Parker and Haswell, 'Text-book of Zoology' (1897), and authorities cited under PARASITISM.

Rouquette, roo-két', **Adrien Emmanuel**, American Roman Catholic priest and author: b. New Orleans, La., 13 Feb. 1813; d. there 15 July 1887. He was educated in France, where he studied law, and was graduated from the University of Rennes in 1833. Returning to America he abandoned law for the priesthood and his cherished career as a missionary to the Choctaw Indians, among whom he had spent some years in his boyhood. In 1859 he established a mission in the Indian village at Bayou Lacombe, and thenceforth devoted his life to the Choctaw people, by whom he was greatly beloved. His writings include: 'Les Savanes, Poésies américaines' (1841); 'Poèmes patriotiques' (1860); 'Catherine Teghekwitha' (1873).

Rouses (rows'iz) **Point**, N. Y., village, port of entry, in Clinton County; on Lake Champlain, and on the Delaware & H., the Rutland, and the Grand Trunk R.R.'s; on the boundary between the United States and Canada; about 160 miles north by east of Albany and 21 miles north by east of Plattsburg. A railroad bridge about one mile in length spans the portion of the lake between the State of New York and Grand Isle, in Vermont. The village has steamer connections with the Lake Champlain ports, and by way of the lake and the Richelieu River with many places in Canada. Rouses Point receives a large part of the custom receipts of the Champlain district. In 1900 the imports were \$15,309,725 and the exports \$5,211,770. The manufactories are a large printing house, railroad repair shops, lumber mills, and machine shops. It has the Charbonneau Institute, a high school, public and parish schools, and two public libraries. Rouses Point was a noted locality in the discovery days, and at the time of the Revolution and the War of 1812. Just on the frontier, on an island, is Fort Montgomery. Pop. (1890) 1,856; (1900) 1,675; (1910) 1,638.

Rousseau, roo-sô, **Jean Baptiste**, French poet: b. Paris 6 April 1671; d. Brussels 17 March 1741. In 1701 he was admitted into the Academy of Inscriptions and Belles-lettres, and his lyric compositions procured him high reputation among the French literati; but his turn

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for satire and his quarrelsome temper at length involved him in disgrace. He was found guilty of having written against persons of consideration, and was exiled from France in 1712. The latter part of his life was spent in the Netherlands, where he obtained a pension from the Duke of Aremberg, which he resigned on having forfeited the favor of that nobleman. An edition of his works was published under his own inspection, by Tonson 1723, and since his death they have been often printed in various forms. One of the best editions is that of Amar, with a commentary and life of the author (1820). The same editor has also published his '*Œuvres Poétiques*' with a commentary (1824).

Rousseau, Jean Jacques, zhōn zhāk, French author: b. Geneva, Switzerland, 28 June 1712; d. Ermenonville, near Paris, 2 July 1778. In 1726 he was articled to an engraver, whose severity disgusted him with his situation. He therefore ran away from his master, and after wandering for some days arrived at Conflignon, where he was received into the house of the curé of the village, and for some time hospitably treated. By this clergyman he was recommended to the notice of Madame de Warens, who sent him to a charitable institution in Turin, where he abjured Protestantism in favor of Catholicism. He left Turin to lead an unsettled existence. In the autumn of 1741 he went to Paris, where, under the recommendation of Réaumur, he read a paper before the Academy of Sciences on certain grand improvements he fancied he had made in musical notation. That body came to the conclusion that, though the improvements were ingenious, they were neither new nor practicable. He lived a very precarious life in the capital, without fixed abode or means of support, until appointed secretary to M. de Montaignu, French ambassador at Venice. After a residence of a year and a half in that city he quarreled with his harsh and avaricious chief, and returned to Paris in 1742, and there earned his living by copying music, employing his leisure hours in the study of natural science. About this time he became intimate with Diderot, Grimm, D'Holbach, and Madame d'Epinay. In 1750 he gained the prize offered by the Academy of Dijon, on the question whether the revival of learning has contributed to the improvement of morals, taking the negative side of the question, it is said, at the suggestion of Diderot. He soon after brought out his '*Devin du Village*,' a comic opera, of which he had himself composed the music. This piece was received with general favor, and the author was almost worshipped by the French; but the appearance of his celebrated '*Letter on French Music*' (1753), in which he pointed out its defects, excited a general storm. Singers and connoisseurs who could not wield the pen contributed to spread calumnies, pasquinades, and caricatures against the author, who retired to Geneva. By his change of religion he had lost the rights of a citizen. He now again embraced Protestantism, and was formally reinstated in the privileges of a free citizen of Geneva. From Geneva Rousseau went to the Hermitage, a retreat near Paris, provided for

him by Madame d'Epinay (1756), but the next year quitted the Hermitage and returned to Paris; and fixing himself at Montmorency, finished his '*Contrat Social*,' his '*Julie, ou la Nouvelle Héloïse*,' and his '*Emile*.'

His celebrated work on education, '*Emile, ou de l'Education*' (1762) was condemned by the Parliament of Paris on account of its religious views, and he himself sentenced to imprisonment. He wished to retire to Geneva, but was also threatened with imprisonment there, and his book was burned by the common hangman. He therefore took refuge in Moitiers-Travers, a small village of the Prussian province of Neuchâtel, where he again found himself among Protestants, the simplicity of whose worship was agreeable to him. Here, too, he obtained a protector and friend in the person of Marshal Keith, governor of the province, but the intrigues of his enemies pursued him even hither. The Geneva clergy assailed him from their pulpits, and he wrote his celebrated '*Letters from the Mountains*' in reply to their attacks. This work, with his '*Letter to the Archbishop of Paris*,' and his '*Dictionnaire Physique Portatif*,' were publicly burned in Paris in 1765. New troubles drove him from Moitiers, and he resided two months on Peter's Island, in the Lake of Biennne. His residence here produced his '*Botaniste sans Maître*.' Neither was he long tolerated here; the authorities of Berne ordered him to quit the country without delay in the severest season of the year. On reaching Paris he became the object of ridicule to the philosophers, but was kindly received by Hume, whom he accompanied to England; but yielding to his unfounded suspicions of his friends in England he left the country, and returned to Paris in 1767. In 1768 he published his '*Musical Dictionary*,' and soon after appeared his melodrama of '*Pygmalion*.' In May 1778, he retired to Ermenonville. The principal traits of Rousseau's character were an enthusiastic passion for love and freedom, a spirit of paradox, an inflexible obstinacy, and a warm zeal for the good of men, combined with a gloomy hypochondria. His influence was great in Europe, particularly in France, where it contributed toward the Revolution. There are standard editions of his works by Augius (1822) and Musset-Pathay (1823-6). Consult also Rousseau's own '*Confessions*'; de Rothschild, '*Letters Inédites de J. J. Rousseau*' (1892); and the '*Lives*' in French by Girardin (1875) and Chuquet (1893), and in English by Morley (1873).

Rousseau, Lowell Harrison, American soldier and legislator: b. Stanford, Ky., 4 Aug. 1818; d. New Orleans 7 Jan. 1869. He was admitted to the bar in 1841, engaged in practice at Bloomfield, Ind., and was a member of the Indiana legislature 1844-5. He served in the Mexican War and in 1849 opened a law office in Kentucky, and became famous as a criminal lawyer. In 1860 he entered the Kentucky senate, but resigned to join the Union army. He was commissioned brigadier-general of volunteers in 1861, promoted major-general in 1862, and fought at Stone River, Chickamauga and Chattanooga. From 1863-5 he was in command of the district of Tennessee and successfully

defended Fort Rosecrans during the siege of Nashville. He took his seat in Congress in 1865, but in the following year resigned it in consequence of being reprimanded by that body for a public assault upon Representative Grinnell of Iowa. He was, however, soon re-elected and served another year. In 1867 he was appointed brigadier-general in the regular army and assigned officially to receive Alaska from Russia and assume control of the territory. He was summoned from this post to testify in the trial for impeachment of President Johnson and was afterward until his death in command of the Department of the Gulf with headquarters at New Orleans.

Rousseau, Pierre Etienne Théodore, French painter: b. Paris 15 April 1812; d. Barbizon, near Fontainebleau, 22 Dec. 1867. He was a pupil of Rémond (1826) and of Lethière, but quickly parted company with all current theories of art, and showed himself an original interpreter of nature, while he fought the battle of the new landscape—"paysage intime"—through the 13 years during which his pictures were excluded from the Salon by the Academical Jury, which has since then been happily abolished. He traveled through the Auvergne and Normandy and painted the scenery with the main object of breathing human feeling into the colors and forms of external nature. He is the central figure of the Barbizon school and must be looked upon as the founder of the modern school of French landscape painting, as opposed to the Romanticism of Claude Lorraine, Poussin and their followers. It has been well said of him: "He occupied the highest place because he was the most perfect master. The grand aspect of landscape and its tenderness are equally familiar to him. He renders with the same mastery the smile of creation and its terrors; the broad open plain and the mysterious forest; the limpid, sun-bright sky or the heaping of the clouds put to flight by storms; the terrible aspect of landscape or those replete with grace. He has understood all, rendered all, with equal genius. The greatest contemporary painters have each a particular stamp, Corot painting the grace; Millet, the hidden voice; Jules Dupré, the majestic strength. Théodore Rousseau has been by turns as much a poet as Corot, as melancholy as Millet, as awful as Dupré; he is the most complete, for he embraces landscape art absolutely."

In 1848 he took up his residence on the edge of the forest of Fontainebleau and derived most of his inspiration from the surrounding scenery. How he drew the motif of his work from this environment is seen in the fine picture in the Metropolitan Museum, New York, 'Edge of the Woods.' Among other characteristic works may be mentioned: 'View of the Valley of Paris and the Banks of the Seine'; 'The Forest Height of Compiègne' (1833); 'Avenue of Isle-Adam'; 'Entrance to the Forest of Fontainebleau' (1862); and 'Marsh in the Landes' (1854); the last two being in the Louvre. His early style was sketchy with some carelessness of touch, although absolutely sincere and impressionistic. Latterly he indulged in excessive detail,

and never seemed to know when his pictures were finished, but all his landscapes were tinged with the deepest poetic spirit. Yet he never really won recognition during his lifetime, and after an unsuccessful auction sale of his works in 1861 thought seriously of seeking a home in some foreign capital. It is said that the sense of this depreciation wore away his health. Yet in the last year of his life he took the medal of honor and since his death the genuine merit of his pictures has been acknowledged and as early as 1873 his 'Scene near Fontainebleau' was sold for \$2,360. Consult: Sensier, 'Souvenirs de Théodore Rousseau' (1872).

Rove-beetles, or Cocktails, names applied to a tribe of Beetles, the *Staphylinidae*, characterized by elytra only about one fourth of the length of the abdomen. A common species is the "Devil's Coach-horse," (*Goërius olens*), a fanciful name given to it from its diabolical aspect when it curls up the abdomen and opens its jaws. These beetles are carnivorous in habits, and are apt to bite if incautiously handled. The habit of cocking the tail has been alleged to have for its object the function of pushing the hinder wings under the short elytra, which are formed by the front wings and which protect the hinder or functional wings. These beetles fly about chiefly in the dusk and at night. The tarsi generally possess five joints.

Rovuma, rō-voo'mā, a river of Africa, which rises east of and near Lake Nyassa, and flows east into the Indian Ocean. It forms the boundary between German East Africa and Portuguese East Africa. It is about 500 miles long. For about 80 miles from the mouth, there are high lands along the banks, and about 160 miles from the ocean are a number of beautiful cascades and waterfalls. The river is navigable for some distance.

Rowan, rō'an, Andrew Summers, American army officer: b. Gap Mills, Va., 1859. He was graduated from West Point in 1881 and after the opening of the Spanish-American war in 1898 was sent to communicate with General Garcia. He made a landing from an open boat near Turquino Peak, Cuba, on 24 April 1898, and with much difficulty succeeded in reaching Garcia, obtained full information of the insurgent army, and made the return trip successfully. He was promoted 1st lieutenant, U. S. A., for this service, and in 1899-1902 was on duty in the Viscayas Group, Philippine Islands. He has since been professor of military science and tactics at the Kansas State Agricultural College. He has written 'The Island of Cuba' (1898).

Rowan, Stephen Clegg, American naval officer: b. near Dublin, Ireland, 25 Dec. 1808; d. Washington, D. C., 31 March 1890. He came to the United States when very young and in 1826 was appointed a midshipman in the navy, receiving promotion to lieutenant in 1837. He saw active service in the Mexican War and in 1855 he was appointed commander. At the outbreak of the Civil War he was in charge of the Pawnee, and on 25 May he engaged in the attack on the Confederate batteries at Acquia Creek, the first naval engagement of the War. He assisted in the capture of Fort Hatteras and was promoted captain and commodore for

ROWBOTHAM — ROWING

his services. He was engaged at Roanoke Island and Albemarle Sound, and later captured Fort Mason, thereby restoring National authority in North Carolina. He was in command of the New Ironsides at Forts Wagner, Gregg, and Moultrie, received the thanks of Congress, and in 1866 was promoted rear-admiral. He became vice-admiral in 1870, and from 1883 until his retirement in 1889 was chairman of the light-house board.

Rowbotham, rō'bōt-am, John Frederick, English Anglican clergyman, poet, and historian: b. Bradford, Yorkshire, 18 April 1859. He was educated at Oxford, traveled extensively on the continent, and took orders in the Church of England in 1891. He was vicar of Ratley in 1892, rector of Huntley in 1895, British chaplain of Budapest and Hungary in 1896, and vicar of Abbotsley 1897-1900. He has published: 'The History of Music' (3 vols., 1887); 'Poetical Works' (1889-90); 'The History of the Troubadours and the Courts of Love' (1895); 'The God Horus, a Novel of Ancient Egypt' (1898); 'The Human Epic' (1902); etc.

Rowe, rō, George Fawcett, English-American actor: b. Exeter about 1829; d. New York 29 Aug. 1889. He made his first appearance on the stage in Australia in 1854; toured through India, China, and Peru, and appeared in New York in 1866 under Mrs. John Wood's management at the Olympic. His most famous part was Wilkins Micawber in Halliday's dramatization of 'David Copperfield.' He also played Silas Wegg in 'Our Mutual Friend,' and many other comic and farcical parts, some in pieces of his own composition, such as 'Brass'; 'The Geneva Cross'; 'Found Drowned'; and 'The Sleigh Bells.' His last appearance was at the Colosseum Theatre, London, as Rufus Potts in 'Forward to the Front,' 27 April 1889.

Rowe, Nicholas, English dramatic poet: b. Little Barford, Bedfordshire, 1674; d. 6 Dec. 1718. He studied at Westminster, entered a student at the Middle Temple; but turned his chief attention to literature. At 24 he produced his tragedy of the 'Ambitious Step-mother'; 'Tamerlane' followed in 1702. His next dramatic performance was the 'Fair Penitent,' remodeled from the 'Fatal Dowry' of Massinger. In 1704 he wrote 'The Biter,' a comedy, which being a failure, he thereafter kept to his own line, and from that time to 1715 produced his 'Ulysses,' 'Royal Convert,' 'Jane Shore,' and 'Lady Jane Grey.' On the accession of George I. in 1715 he was made poet-laureate. He wrote a few tender and pathetic ballads, translated Lucan's 'Pharsalia,' and edited the plays of Shakespeare (1709). The memoir prefixed to the plays contains much traditional matter judiciously presented.

Rowing, Mechanics of. Rowing is the method of propelling a boat by the use of oars. It consists of two parts—the stroke, and the feather, which are executed by a series of very complicated motions designed to apply a maximum of available motive energy in pushing the boat through the water, and at the same time insure the least amount of deviation from a straight course.

In preparing to row, the oarsman sits on the thwart, facing the stern and exactly opposite the handle of his oar, the loom of which

rests in the rowlock with the button on the inner side of the thowl pin. To obtain the maximum effect from the power exerted, he should sit about two inches from the after edge of the thwart, the body being held square and upright, the back straight and rigid, the feet pressed firmly against the opposite stretcher or foot board with the heels close together and the toes apart, so as to keep the knees separate. The handle of the oar should be held firmly by both hands which should be about three inches



FIG. 1.— Position beginning of stroke.

apart, with the outside one close to the end of the handle, the fingers being above and the thumb underneath. The grasp should be a flexible hold with the fingers and not a clutch with the whole hand. The forearms should be kept below the level of the handle, with the elbows down, close to the sides of the body. The wrists should be relaxed and dropped, so that the oars will lie flat upon the surface of the water.

The stroke is characterized by three distinct phases—the beginning, the pulling through, and finishing, and the "recovery" which includes



FIG. 2.— Position half-way through stroke.

the "feather." In taking the stroke, the body is inclined forward, the backbone being kept straight and rigid, the chest thrown forward and held up as high as possible, while the stomach is kept well out and down between the legs. The arms should reach out perfectly straight from the shoulders to the wrists, and the action of the shoulder joints and the hips should be

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perfectly free and easy. In reaching forward, the oar handle is grasped firmly by the fingers, and the hands are shot out quickly straight from the body, and as soon as the oar has passed over the knees, the wrists are raised so as to bring the blade at right angles to the surface of the water and preparatory to dipping it, at the beginning of the stroke when the arms reach the extreme limit of their forward movement di-

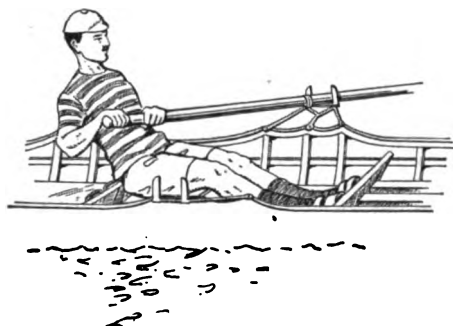


FIG. 3.— Position finishing of stroke.

rectly over the stretcher. At this instant, the hands are raised and the blade is dropped firmly into the water and buried until it is covered up to the shoulder. The stroke is pulled through by bracing the muscles of the back, loins, and shoulders, and by swinging the body backward, with the feet pressing hard against the stretcher, and the arms held perfectly rigid. The weight of the body is thus transferred from the seat to the stretcher and the handle of the oar, and when the body, in swinging backward, has reached a perpendicular position, the oar handle is pulled back home to the chest until the

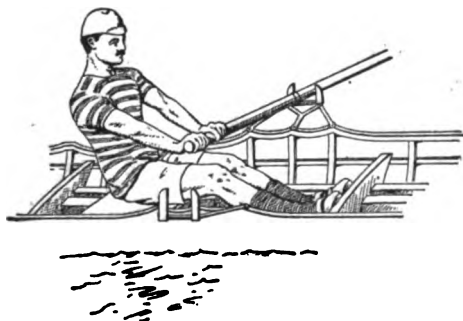


FIG. 4.— The "Recovery." (Position of the hands and wrists in the act of feathering.)

knuckles almost touch the bottom of the breast bone, by the action of the shoulders and a gradual bending of the elbow joints, while the forearms are kept as nearly as possible in a horizontal position.

At the finish of the stroke, the whole strength of the arms and shoulders is exerted, but care is taken not to use the biceps, which if exerted, would tend to raise the arms and consequently bury the blade. At this point, the body is not allowed to "wait," but is continued to swing back until it is overtaken by the hands. When the hands reach the breast bone, they are dropped quickly about two inches so as to lift the blade out of the water, then turned back-

ward at the wrists until the knuckles touch the breast, so as to produce the "feather," in which the flat of the blade is made parallel with the surface of the water; then the arms are shot forward again close along the legs, accompanied by the forward swing of the body, in the "recovery." A quick recovery is effected by keeping the back straight and rigid, the knees not dropped too low, and by bracing the muscles of the body, and especially those of the stomach.

The operations of rowing from a fixed, or from a sliding seat, are very much the same. In the latter case, the stroke is taken by extending the arms to their full length, and swinging the body forward, simultaneously, with the assistance of the foot straps on the stretcher, the knees being kept slightly apart and the back straight. When the oar is dipped at the beginning of the stroke, the knees are straightened out gradually, and the body thrown backward, simultaneously, so that at the finish of the stroke, the legs are straight and the body and shoulders thrown well back. The recovery is effected by bringing the body to the upright position by the action of the hips, and then the motions described above are repeated in taking another stroke.

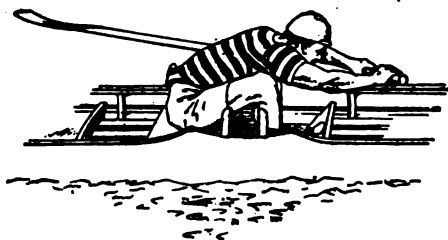


FIG. 5.— A common but very bad position. (Beginning of stroke.)

The motion of the body should be as constant and steady as that of a pendulum, while the action of the hands and the wrists, producing the dipping and the feathering, should be entirely free from jerks. When the boat contains a number of oarsmen, each one keeps his eyes on the back of the oarsman opposite to him, and times his swing from it, or in other words "keeps eyes in the boat." In governing his blade it is generally understood that the blade should be kept square or perpendicular to the surface of the water, but in properly constructed boats the thowl is slightly inclined aft, so that the blade is given a slight inclination forward, and presses against the water at an angle a little off the perpendicular. This obviates any tendency to row deep. On the other hand, if the thowl is inclined too much, the blade will have a tendency to fly out of the water.

A boat is "held" or has its headway stopped, by laying the blade flat and then sinking its forward edge slightly into the water. The blade is thus buried at an acute angle and checks the way of the boat gradually until it has been sufficiently reduced to allow of the blade being reversed square, to "back water." If the boat is under much headway, any attempt to back water before it has been held, would be attended with disastrous results, as the resistance would prove greater than the strength

ROWLAND—ROWTON HEATH

of the oar, and make him catch a "crab" and throw him flat on his back, if it did not cause a fracture of the oar.

In sculling, a scull or oar is held in each hand, instead of one oar handle being held in both hands, as in rowing. The grip on the scull is governed by the rules applicable to the grip on the oar handle in rowing, but with the exception that, the thumb should cap the butt of the scull handle with the top joint and not clasp around it. The action of the body, legs, arms, wrists and hands, are also the same as in rowing, but, in sculling some advantage may be gained by allowing the body to swing farther back at the finish of each stroke. Both hands should work together, and both blades should enter and leave the water at the same time. It is obvious that if one hand lags behind the other in any one of these movements, the resulting uneven strokes would deflect the boat from a straight course.

W. MOREY, JR.,
Consulting Engineer.

Rowland, rō'land, Henry Augustus, American scientist: b. Honesdale, Pa., 27 Nov. 1848; d. Baltimore, Md., 16 April 1901. He was graduated from the Rensselaer Polytechnic Institute in 1870, and taught for a year in Wooster College, Ohio, but in 1872 returned to the Institute, where he was instructor in physics, becoming assistant professor in 1874. He studied for a time in Germany, and in 1876 accepted the chair of physics at Johns Hopkins University, which he occupied until his death. He was a member of the Electrical Commission in Paris in 1881, and was elected to the National Academy of Science in that year. He was the inventor of a greatly improved process of ruling large diffraction gratings directly on concave mirrors, constituting what is known as the dividing engine (q.v.), with which he succeeded in making photographs far superior to any which had then been made. He made numerous valuable investigations and experiments, particularly in electricity, among them an extremely accurate determination of the ohm, a work which he afterward extended under the government. He was author of more than 100 scientific papers and monographs, among which are: 'Magnetic Permeability' (1873); 'Magnetic Effect of Electric Connection' (1876); 'Research on the Absolute Unit of Electrical Resistance' (1878); 'On the Mechanical Equivalent of Heat' (1880); 'Photographs of the Normal Solar Spectrum' (seven plates, 1886); etc.

Rowlandson, rō'land-sōn, Mary White, American captive among the Indians. She was carried away by the Indians on the occasion of an attack on Lancaster, Mass., 10 Feb. 1675, during King Philip's war. For a time she was kept in an Indian village near the site of Petersham, Worcester County, and later was taken by her captors across the Connecticut, and after about three months was redeemed. Her 'True History' of her captivity and restoration was printed at Cambridge, New England, and in London, in 1682. A fifth edition was prepared by Joseph Willard (1828). The work, though not always clear as to detail, is interesting, and throws a graphic sidelight on Indian existence with its cruelty and squalor.

Rowlandson, Thomas, English artist: b. London July 1756; d. there 22 April 1827. He

was sent at 15 to Paris, and there studied art and gained a taste for pleasures of the town.

The £7,000 left him by a French aunt he gambled away, yet he hated debt, and maintained his uprightness of character. He traveled over England and Wales, and enjoyed life to the full in his tavern and the company of friends like Morland, Gilray, and Bunbury. Rowlandson possessed rare dexterity of touch and fertility of imagination; and, though not seldom vulgar, he was never feeble. He was a relentless hater of Napoleon, belittling his greatness by countless travesties. Some of his best known works are his 'Imitations of Modern Drawings' (1784-8), and his illustrations to 'Syntax's Three Tours,' the 'Dance of Death,' Sterne's 'Sentimental Journey,' 'Peter Pindar,' the 'Bath Guide,' 'Munchausen,' etc.

Rowson, rō'sōn, Susanna Haswell, American actress and author: b. Portsmouth, England, 1762; d. Boston 2 March 1824. Her first work, the novel, 'Victoria,' appeared in England in 1786, and in 1792 she made her stage debut at Edinburgh. In 1793-6 she acted in the United States, closing at Boston with a comedy by herself, 'Americans in England.' From 1797 until her retirement in 1822 she conducted with much success a seminary for young ladies, first at Boston, and from 1800 at Medford. Her most popular work was 'Charlotte Temple, or a Tale of Truth' (1790), which had in its time wide sale, but is called by Wendell a "comically extravagant example" of a literary manner then much in favor. Further she wrote, among several volumes: 'The Inquisitor' (1788); 'The Volunteers' (1793); 'Miscellaneous Poems' (1804). There is a memoir by Nason (1870).

Rowton, row'tōn, Montagu William Lowry-Corry, 1ST BARON OF, English lawyer and philanthropist: b. 8 Oct. 1838; d. London 9 Nov. 1903. He was educated at Trinity College, Cambridge, became a barrister in 1863, and entered upon a successful career as a lawyer. He was secretary to the Earl of Beaconsfield in 1866-8 and in 1874-80, and was secretary of the special embassy sent to the Berlin congress in 1878. He was created a baron in 1880. He established the Rowton lodging houses in London some three years before the Mills Hotels were instituted in New York. They were built with the idea of furnishing decent and comfortable lodgings for workmen and furnishing them also with well-cooked and substantial food at very moderate rates, yet at the same time with the intention of keeping the enterprise on a paying basis. He was chairman of the Rowton Houses and of the Guinness Trust until his death.

Rowton Heath, England, a place near Chester, which was the scene of a battle 24 Sept. 1645, in which the Parliamentary forces defeated the Royalists. After the crushing disaster of Naseby, King Charles I. fled to Wales, and next formed the desperate project of marching north to Montrose. Chester was then being besieged by Sir William Brereton, but the king succeeded in finding an entrance, and charged Sir Marmaduke Langdale to raise the siege. The Parliamentarians had just been reinforced by Poyntz's Yorkshire horse when Sir Marmaduke attacked them. He was utterly defeated, with

ROXBURY—ROYAL GEORGE

a loss of 300 killed and 1,000 prisoners, and the disaster, added to Philiphaugh, stripped the unhappy king of his last hope.

Roxbury, röks'bür-ī, Mass., now a part of the city of Boston, annexed in 1867. It has a diversified surface, a remarkable alternation of hills and hollows, which furnish opportunities for picturesque building sites, and which has made a great portion of Roxbury a residential section. There are a number of manufactories, among which are cotton and woolen mills, machine shops, cordage factories, carpet factories, and organ works. A free Latin school was established in Roxbury in 1645. The place was for many years the scene of the labors of John Eliot (q.v.), the "Apostle of the Indians," and his remains are in the "ministers' tomb" in the old burial ground. It is also the birthplace of Joseph Warren (q.v.) of Revolutionary fame. The township of West Roxbury, which contained the villages of West Roxbury and Jamaica Plain, was set off from Roxbury in 1852. When Roxbury was annexed to Boston it had a population of about 40,000.

Royal Academy of Arts, The. See **ACADEMY OF ARTS, THE ROYAL**.

Royal Academy of Music, London, England, an institution established in 1823, mainly through the exertions of Lord Burghersh (afterward Earl of Westmoreland), and incorporated by royal charter in 1830. The purpose for which it was founded was to afford a first-class musical education in the various branches of music, and to properly equip those who make music a profession. It receives a grant from the government, and from this and other sources is able to award to successful competitors a large number of scholarships and prizes. Instruction is given in musical composition, singing, and instrumental playing. Concerts are given at intervals by the pupils. Connected with the R.A.M. are associates, fellows, and licentiates, besides honorary members. Among its principals have been Sir George Macfarren and Sir A. C. Mackenzie.

Royal and Protestant Order of Saint John. See **ORDERS, ROYAL**.

Royal Arcanum, The, the name of one of the largest and strongest of the fraternal and beneficial societies in the United States. It was first organized 23 June 1877 at Boston, Mass., by Dr. Darius Wilson and John Andrew Cummings. The original council in Boston had but nine members. Other councils were soon established in the same city, and the order spread rapidly throughout the New England States. It has since grown at a rapid rate, and there are councils in every State and in almost every city and town in the Union. The business of the order is conducted in Boston, where the society owns a substantial building, in which the supreme council meets. The society is governed through councils which are dominated by the supreme council or governing body. The membership qualifications are good health and character; and the age limit is embraced in the ages between 21 and 55. Benefit certificates are issued for \$1,500 and \$3,000, payable at the death of a member. Should a member desire to increase his insurance over the limit fixed by the society he can do so by making application for the in-

crease in the Loyal Additional Benefit Association, formed in 1889, practically within the Royal Arcanum, and incorporated in 1890 under the State laws of New Jersey.

The officers of the supreme council or governing body of the society consist of supreme regent, supreme vice-regent, supreme orator, sitting past supreme regent, supreme secretary, supreme treasurer, supreme auditor, supreme chaplain, supreme warden, supreme sentry, and legal adviser. The grand councils and subordinate councils have a similar roster of officers.

The remarkable growth of membership in the Royal Arcanum is evidenced by the following official figures:

	Membership	Grand Councils	Subordinate Councils
1898.....	193,573	22	1,762
1902.....	249,644	27	2,004
1903.....	258,746	28	2,045

For the same period the total number of deaths in the order and the total amount of benefits paid were as follows:

	Number of Deaths	Amounts Paid
1898.....	16,479	\$47,886.199
1902.....	25,714	73,817.678
1903.....	27,480	76,190.352
Emergency fund 31 Oct. 1902.....		\$1,813.141
Emergency fund 28 Feb. 1903.....		\$1,885.786

The emblem of the association is a royal crown within a circle, on the circumference of which are 10 small Maltese crosses with the motto, "Virtue, Mercy, and Charity."

Royal Arch Masons. See **MASONIC FRATERNITY**.

Royal College of Music, London, England, an institution established in 1883 in South Kensington under the presidency of the Prince of Wales, afterward Edward VII. It was endowed at its commencement by gifts to the amount of \$630,000. Pupils of either sex are admitted either as fee-paying students or as scholars or exhibitioners. There are 52 open free scholarships and 11 close free scholarships, besides the council exhibitions, the Savage Club exhibition, the exhibitions of the associated board of the Royal Academy of Music (q.v.) and the Royal College of Music, etc. Prizes and medals are also awarded to the students in accordance with the results of examinations. The associateship may be obtained by outsiders as well as pupils on passing a qualifying examination, and entitles the holders to use the initials A.R.C.M. The professorial staff includes several eminent names.

Royal Crown of Hawaii, Order of. See **ORDERS, ROYAL**.

Royal Family, The, in its widest sense, as referring to Great Britain, embraces all the British descendants of the royal house; in its narrower sense it includes only the queen-consort and queen-dowager, with all the lineal descendants of the sovereign. The husband of a queen-regnant is not as such a member of the royal family. The members of the royal family have precedence before all peers and officers of state; but an heir-presumptive has no rank or precedence as such, as his position may be altered by the birth of an heir-apparent.

Royal Fern. See **OSMUNDA**.

Royal George, English man-of-war, sunk in Portsmouth harbor, England, 29 Aug. 1782.

ROYAL GEOGRAPHICAL SOCIETY—ROYALL

While undergoing repairs at the keel the vessel suddenly careened and filled with water, going down with all on board. The ship, the principal vessel of Lord Howe's fleet, was commanded by Admiral Kempenfeldt, and carried about 1,100 persons, including nearly 300 women and children. The disaster was commemorated in an elegy by Cowper, 'The Loss of the Royal George.' The first attempt to raise the vessel was made in 1817; but it was not until 1839 that portions of the ship and its cargo were brought to the surface, when the sunken mass was exploded by means of great quantities of gunpowder.

Royal Geographical Society. See GEOGRAPHICAL SOCIETY, ROYAL.

Royal Institution of Great Britain, an institution founded in 1799 by Count Rumford, Sir Joseph Banks, and other men of science, and incorporated in 1800. It was reconstituted on a wider basis in 1810, and has for objects the promotion of scientific and literary research, the teaching of the principles of experimental science, the exhibition of the applications of these principles to the arts, and the affording of opportunities for study. Many distinguished chemists and physicists have conducted their researches in the laboratories. The library contains some 60,000 volumes.

Royal Lion, Order of. See ORDERS, ROYAL.

Royal Louis Order, The. See ORDERS, ROYAL.

Royal Observatory, Greenwich, the famous English observatory founded by Charles II. in 1675. The first observation was made 19 Sept. 1675. The director of the observatory is styled the astronomer royal, and is under the official control of the admiralty, but receives his appointment directly from the prime minister, and holds office by warrant under the royal sign manual. The largest instrument is a 28-inch refractor, with a spectroscope attached which has been recently mounted. Photographs of the sun are taken on every available day, and after being measured are carefully stored for reference. Magnetic and meteorological observations, made continuously, form an important branch of the works. The chronometers used in the English navy are purchased, and generally examined at the observatory. Hourly and daily time-signals are sent out from the observatory through the post-office telegraphs giving Greenwich time to all parts of the country.

Royal Order of Victoria. See ORDERS, ROYAL.

Royal Orders. See ORDERS (ROYAL) AND DECORATIONS OF HONOR.

Royal Society of Edinburgh, a society which was incorporated in 1783, having been developed from the Philosophical Society of Edinburgh, commenced in 1739. Among its early members were Hume, Reid, Edmund Burke, Hutten, Dugald Stewart, and James Watt; and among its presidents have been Sir Walter Scott, Sir David Brewster, the Duke of Argyll, Lord Moncrieff, and Sir William Thomson.

Royal Society, London, an organization which owes its origin to a club of learned men who were in the habit of holding weekly meet-

ings in London as early as 1645, but the year 1660 is generally given as the year of its foundation. Charles II. took much interest in the proceedings of the society, and in 1682 granted a charter to the "President, Council, and Fellows of the Royal Society of London for Improving Natural Knowledge." Lord Brouncker was first president of this incorporated Royal Society. Meetings are held weekly from November to June for the purpose of reading and discussing scientific papers; and the more important of these are published in the annual 'Philosophical Transactions,' first issued in 1665, and now forming a most valuable series. Accounts of the ordinary meetings, with abstracts of papers, etc., appear also in the periodical 'Proceedings,' begun in 1800. Scientific research has at all times been both initiated and encouraged by the Royal Society, and many of the most important scientific achievements and discoveries have been due to its enlightened methods. It deservedly enjoys an influential and semi-official position as the scientific adviser of the British government, and not only administers the \$20,000 annually voted by parliament for scientific purposes, but has given suggestions and advice which have borne valuable fruit, from the voyage of Captain Cook in the Endeavour in 1768 down to the Challenger expedition, more than a century later. The society has an independent income.

Royal University of Ireland, an examining institution with its seat at Earlsfort Terrace, Dublin. It was founded in 1880 in pursuance of the provisions of the University Education (Ireland) Act, 1879, to take the place of the Queen's University, a similar institution established in connection with the Queen's Colleges (q.v.). The Royal University corporation consists of a chancellor, a senate, and graduates, the government being vested in the chancellor and senators, the latter not to exceed 36 in number. It has power to confer all such degrees and distinctions as are conferred by any university in the United Kingdom except in theology; these may be bestowed on all male and female students who have matriculated in the university and passed the prescribed examinations, no residence in any college or attendance at any course of instruction in the university being obligatory on any candidate for a degree other than a degree in medicine or surgery, the university in this respect resembling that of London. An act of 1881 provided for the payment of \$100,000 a year out of the surplus funds of the Irish Church for the purposes of the university. The university has a considerable staff of examiners, but no professors. A certain number of exhibitions and scholarships are conferred on those who pass examinations with high distinction.

Royall, roi'al, Isaac, American soldier: b. Massachusetts about 1720; d. England October 1781. He was a wealthy citizen of Medford, was its representative for many years in the general court, and for 21 years was a member of the executive council. He served in the French war, and in 1761 was appointed brigadier-general, the first resident of New England to attain that rank. At the outbreak of the American Revolution he remained loyal to the crown, and in 1775 left the country. His estates were confiscated and he was proscribed in 1778, but seems to have borne no enmity to his native land.

ROYCE — RUBBER MANUFACTURES

as he bequeathed 2,000 acres of land in Worcester County to found a law professorship at Harvard, and made various other patriotic bequests. The town of Royalston, of which he was one of the original proprietors, was named in his honor, and the chair of law was established in his name at Harvard in 1815.

Royce, rois, **Josiah**, American philosopher and educator: b. Grass Valley, Nevada County, Cal., 20 Nov. 1855. Graduated (1875) from the University of California, he studied also at Leipsic and Göttingen (1876) and the Johns Hopkins University (1877-8), and in 1878-82 was instructor in English in the University of California. From 1882 to 1885 he was instructor in philosophy at Harvard, in 1885 was appointed assistant professor, and in 1892 was elected to the professorship of the history of philosophy, which he still retains. His views are very similar to those of T. H. Green (q.v.), the great English representative of the Neo-Kantian or Neo-Hegelian movement, and his position may be studied in the historico-critical work, 'The Spirit of Modern Philosophy' (1892). His clear, distinguished style as writer and lecturer has served to enhance his reputation in the United States, among whose leaders in philosophic inquiry he is highly ranked. Besides 'California from the Conquest to the Vigilance Committee of 1856' (1886), and 'The Feud of Oakfield Creek' (1887), a work of fiction, he has written: 'A Primer of Logical Analysis' (1881); 'The Religious Aspect of Philosophy' (1885); 'The Conception of God' (1897); 'Studies of Good and Evil' (1898); 'The Conception of Immortality' (1900; Ingersoll lecture on immortality, 1899); 'The World and the Individual' (1900-1; Gifford lectures, 1899-1900); 'Outlines of Psychology' (1903).

Roycrofters, roi'kröf-têrz, **The**, the name applied to a colony of artisans and artists living at East Aurora, Erie County, N. Y. The founder of the Roycroft colony was Elbert Hubbard (q.v.), who in 1893 established here a printing establishment and a monthly periodical called 'The Philistine.' Hubbard, imbued with a socialistic doctrine similar to that of William Morris (q.v.) of England, gradually gathered about him numerous kindred spirits, and since 1900 the Roycrofters have been producing hand-made books, furniture, and wrought-iron work, and have established schools of music, painting, and sculpture. There are numerous workshops, a library, church and other buildings at East Aurora, occupied by the Roycrofters, who have increased in number until the colony numbers several hundred.

Royer-Collard, rwä-yä-kö-lär, **Pierre-Paul**, French statesman and philosopher: b. Sompuis, Marne, 21 June 1763; d. Chateauvieux 4 Sept. 1845. He was educated at the colleges of Chaumont and Saint Omer, and later became an advocate in Paris. He was an active participant in the pre-Revolutionary movement, and was elected one of the representatives of the commune of Paris. During the ascendancy of the Jacobins he retired to his native province, where he succeeded in avoiding their suspicions. In 1797 the department of Marne sent him to Paris as a member of the Council of the Five Hundred, and there he endeavored to serve the republic. But his sympathies were not with the Napoleonic

regime. His correspondence with Louis XVIII. began at this period, which was also marked by his temporary retirement from political life. In 1809 he was appointed to the chair of philosophy in the University of France, and later became known as the head of the "doctrinaire" school. At the Bourbon restoration in 1814 he was made councillor of state, and chief of public instruction. In 1827 he was admitted to the French Academy, and in 1828 became president of the chamber of deputies. In 1842 he retired from public life. He left few published works, but these reveal him as at all times on the side of freedom and enlightenment. In the support of the house of Bourbon he sought the overthrow of an empire which seemed to him to have usurped greater privileges than those of the monarchy it supplanted. His biography has been written by Barante (1878), Spuller (1895), and Vingtain (1858). For an outline of his philosophy, consult Jouffroy's translation of Reid.

Roze, rôz, **Marie**, French opera singer: b. Paris 2 March 1850. She was a favorite opera singer of Paris for many years. Her first appearance in London was in 1872. There she was received with favor also, and sang in Italian opera during the next four years. She was married to Mr. Mapleson, her manager, in 1897, and sang for two years in America, when she returned to the London operatic stage.

Ruatan, roo-ä-tän', or **Roatan**, rô-ä-tän', an island of Central America, in the Bay of Honduras, is 30 miles long by 10 miles wide. Its coast has dangerous reefs, except at the south, where there are a few good roadsteads, and at the east, where there is one, called Port Royal, which is ample and deep, though difficult of access. The soil is fertile and the cocoa-palm, figs, and vines grow spontaneously, while all vegetable growth is abundant. Ruatan has three dependencies, Bonaca, Utila, and Barbareta, comprising the colony of the Bay Islands. These islands were ceded to Honduras in 1856 by Great Britain. Pop. from 2,000 to 4,000.

Rubaiyat, roo'bäi-yät, a Persian word, the plural of *rubai*, signifying quatrain or epigram. Various forms of the *rubai* were borrowed from the Arabic, and one specific form was invented by Abul Khair of Mahna. It is this style of *rubai*, affording the most concise expression to views of religion and philosophy, that was developed by Omar Khayyam (q.v.), a selection of whose quatrains, translated into English by Edward Fitzgerald (q.v.), became so widely known as popularly to be called 'The Rubaiyat.'

Rubber. See INDIA RUBBER.

Rubber Manufactures, **American**. The rubber industry in the United States began with the discovery of the process of vulcanization in 1840. It had been used by the South American natives before the discovery of America. It was not until 1770, however, that rubber was utilized in any civilized country; then a few pieces of it were sent to England to be used by artists for erasing pencil-marks. The first rubber imported into this country, in 1800, came in the form of bottles, and was looked upon simply as an interesting curiosity. During the next 20 years sea-captains coming from South American countries were constantly bringing with them specimens of "gum elastic," as it was then more generally

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called, simply as the strange product of a distant land. In 1813 a patent was granted Jacob Hummel, of Philadelphia, for a gum-elastic varnish, of which there seems to be no further mention. Some 10 years later, in 1823, a Boston sea-captain, coming from South American ports, brought with him a pair of rubber shoes which excited the greatest interest. In 1825 500 pairs of rubber shoes, made by the natives along the Amazon, were brought into Boston; they were thick, clumsy, and unshapely, but they sold readily, at \$3 to \$5 per pair; for, with all their heaviness and awkwardness, it was found that they were a secure protection against dampness. During the next 15 years probably over 1,000,000 pairs of these shoes were brought into this country and sold at these very considerable figures.

In 1831 it was discovered that by dissolving the crude rubber in spirits of turpentine and adding a quantity of lampblack there could be obtained a varnish which, when spread over leather or cloth, gave a hard, smooth, impervious surface. The Roxbury India-Rubber Company was organized and received its charter in 1833. Its business was prosperous, but was actually doomed to speedy failure as the preparation used was not durable, melting and sticking in summer and cracking in winter. Charles Goodyear, a bankrupt hardware merchant of Philadelphia, became interested in the method, and learning of its imperfection set himself to remedy the fault. By 1836 the Roxbury Company had ignominiously failed. After six years of experiment, in 1838 Goodyear found a solution of the difficulty. The story goes that as he was sitting by the kitchen stove descanting on the possibilities of rubber, he struck a handful of rubber and sulphur against the hot stove, thus accidentally discovering the secret of vulcanization.

In 1840 he secured the assistance of two New York capitalists and built a factory in Springfield, Mass. Here, four years later, he took out a patent for preparing rubber by the process of vulcanization, and began to sell licenses for the manufacture of various articles under this patent. The license to manufacture rubber boots and shoes was sold to Leverett Candee, of New Haven, the founder of L. Candee & Co., a company which has continued to the present time an important factor in the American rubber footwear industry. The license to manufacture rubber gloves he granted to the Goodyear's India-Rubber Glove Manufacturing Company, of Naugatuck, Conn. The license to manufacture door-springs, which seemed a very trivial branch of the industry, but which later grew to considerable proportions, was granted to Daniel Hodgman, of New York; and various other licenses were given out to different companies. All branches of the rubber business as we find it in this country to-day took their permanent rise from the date of Goodyear's patent. Mechanical goods, and especially belting, began at this time to receive considerable attention. Some rubber garments were also made. An immediate demand for the poncho—a blanket for horsemen, with a hole in the centre for the rider's head—came from the far Southwest and from Mexico; and various druggists' sundries also began to find their way into the market. With the discovery of hard rubber the field of rubber's usefulness was still further largely extended. But the importations of crude rubber

at Salem, Mass., to which port the greater part of the rubber then imported was brought, amounted in 1851 only to 334,000 pounds, in 1852 to 1,961,000 pounds, and in 1854 to 2,055,000 pounds.

The Civil War gave a great impetus to the rubber industry, notably to the clothing branch; blankets were needed for the soldiers, and the government gave out large contracts. The boot and shoe industry increased rapidly with the other branches of rubber manufacture, so that, from an output in 1860 of the value of \$795,000, the yearly output in 1870 had increased to \$8,000,000. The manufacture of mechanical goods took a rapid start shortly after the War. This was owing to a considerable extent to the great increase of railroad building at that time. The railroads called for large quantities of packing, and for hose to be used in conveying steam and gas. The impetus given to manufacturing in general made an increased demand for rubber belting. The first rubber belt was patented in this country in 1836, but this particular branch of the rubber industry reached no considerable size until after the War, when rubber belting was in demand for mills, factories, and elevators, and especially for all outdoor machinery. It possessed several advantages over leather belting: its lower price, the greater friction between the belt and the wheel, and the fact that it was not affected by exposure or by moisture. The making of rubber tires began in 1877, with the solid tire, which gave way to the cushion tire. It in a short time and in a less degree was displaced by the pneumatic tire. It is estimated that at least 3,000,000 pounds of rubber are now annually used in the making of bicycle tires, and twice as much more for tires for carriages, wagons, and automobiles. Next in importance to rubber tiring, which stands next to hose, belting, and packing, comes the making of rubber mats. This industry has enjoyed a constant and rapid growth, until we have mats for floors and for stairs, pitcher-mats for tables, and coin-mats for counters—and all in an infinite variety of design. Rubber tiles, which have recently come into use, are desirable not only because of their cleanliness and durability, but for their noiselessness. The introduction and rapid growth of the typewriter industry has consumed a constantly increasing quantity of rubbers in various details of typewriter construction. Several hundred thousand pounds of rubber are used each year by one company alone in the manufacture of rings for preserving jars. The making of pencil erasers consumes a large quantity, and there is a large annual output of goring, in which rubber thread is used. A quarter of a million dollars' worth of rubber is used in this country each year in the making of cushions for billiard-tables. Other important items are rubber stamps, tennis balls, footballs, golf-balls, etc. There are now about 40 companies making rubber mechanical goods, with an aggregate capital of about \$30,000,000, employing 10,000 men, and having an annual output valued at from \$35,000,000 to \$40,000,000. Our export trade in mechanical goods amounts to about \$2,000,000 a year.

The attempt to utilize the waterproof properties of the caoutchouc gum in the manufacture of clothing was one of the earliest directions which rubber invention took, especially in Eng-

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land. In this country very little was done in this department of rubber manufacture until the Civil War, and the great demand to which it gave rise for rubber coats and blankets. After the War rubber coats continued to be made, but they were chiefly of a heavy sort and almost solely for men. For women's use the light gossamer came out about 1875. But excessive competition resulted in such deterioration of quality as seriously to affect its popularity. About 1885 the manufacture of mackintoshes for both men and women was started in this country. About 20 factories, with a capital of more than \$6,000,000, manufacture mackintoshes. Another important branch of the rubber industry in the United States is the making of druggists' sundries. The pioneer in this industry was the Union Rubber Company, located in Harlem. It derived its license direct from Goodyear, and began to manufacture druggists' sundries in 1857, making syringes, water-bottles, bandages, air-pillows, and air-cushions. The atomizer was a later development, and came into vogue in 1880. There are some 10 companies engaged in this branch of the business in this country at the present time, with a capital of between \$4,000,000 and \$5,000,000, and with an annual output of about \$4,000,000. After Goodyear had brought his vulcanization process to a fair degree of perfection he turned his attention to the making of hard rubber, in which he was greatly assisted by his brother Nelson, who in the year 1851 obtained a patent for the production of hard rubber. Hard rubber differs from soft rubber in containing a much larger proportion of sulphur, and in the degree of heat used in vulcanization, which is considerably higher than that at which soft rubber is vulcanized. The first article made in hard rubber to any considerable extent was the comb. It is said that Goodyear's experiments in this line made his combs cost twenty times as much as the ivory combs then in use; but the rubber comb has now practically displaced all other kinds. For twenty years after the invention of hard rubber the India-Rubber Comb Company practically enjoyed its monopoly; but other companies entered the field after the expiration of the Goodyear patent. In 1898 the American Hard Rubber Company, with a capital of \$2,500,000, was formed, and absorbed the various individual companies engaged in this line of manufacture. The annual output of hard rubber goods is in the neighborhood of \$3,000,000, and about 2,500 operatives are employed in this branch of the rubber trade. The principal articles of manufacture are electrical appliances, combs, syringes and syringe fittings, fittings for pipes, buttons, harness trimmings, and various desk articles, such as ink-wells, penholders, and rulers. It is the boot and shoe industry, however, that has led in rubber manufacture in this country from the very first. For many years it used the great bulk of the rubber imported into this country; but the later development of other branches of the rubber business has been so large that now the boot and shoe industry comprises probably not over 40 per cent of the rubber manufactured in the United States. From an annual output in 1860 of the value of \$795,000, the value of the rubber boot and shoe product grew in 1870 to \$8,000,000, in 1880 to \$16,000,000, in 1890 to \$24,000,000, and in 1900 to \$40,000,000. There are now a dozen or more

large factories engaged in the manufacture of rubber boots and shoes. Their combined daily capacity is over 180,000 pairs of boots and shoes; they employ 17,000 workmen, and their aggregate capital is \$50,000,000. Their aggregate output for 1900 was 40,000,000 pairs of boots and shoes. We have as yet done comparatively little in the way of exporting rubber boots and shoes, our annual exports in this line rarely exceeding \$1,000,000. The reason has been chiefly that the American demand has been so large and has so constantly increased that our manufacturers have not yet felt the necessity of looking for a broader field. They have consequently made no effort to appeal to foreign buyers by making rubbers particularly suited to their local conditions. The rubbers which we export go chiefly to England, the Continent, Japan, and China. A very important event in the history of the rubber boot and shoe industry in the United States occurred in the fall of 1892, when the United States Rubber Company purchased nearly all of the large footwear interests in the United States. This centralization of the rubber industry has already resulted in conspicuous economies; for while the different factories have remained under their former individual management, they have shared their individual advantages in common, the patents and secret processes of one factory becoming the property of all. In this way all the improved methods, a part of which each factory enjoyed before, are now shared equally and fully by all the different factories. There has also been a great saving in the matter of purchasing crude rubber, a large single purchase being made at a great advantage over a number of smaller scattered purchases. In reducing the necessity of carrying large stocks, in diminishing the duplication of a vast number of expensive lasts, and in various other ways, marked economies have been effected, while at the same time the quality of the goods has been more uniformly excellent than heretofore. The combination of all that was best in the methods of the different companies has proved a potent agency in advancing the rubber footwear industry in this country toward the universal goal of all industrial enterprises—better product at a lower cost. The entire rubber industry in the United States, in its five branches, footwear, mechanical goods, clothing, druggists' sundries, and hard rubber, consumes considerably more than one half of the rubber manufactured in the world. The consumption of rubber in this country increased from 9,830,000 pounds in 1875 to 17,835,000 pounds in 1880, to 31,949,000 pounds in 1890, and to 50,000,000 pounds in 1900. To this large amount must be added the rubber which is obtained by the reclaiming process, which has now been brought to such a state of perfection that very little rubber goes to waste, old rubber articles being collected and subjected to a process which eliminates from the compound everything but the rubber. It is probable that the amount of this reclaimed rubber used annually in this country equals 40,000,000 pounds, making the total yearly consumption of rubber 90,000,000 pounds. The rubber industry in the United States in 1901 is 20 times what it was in 1860, five times what it was in 1870, and has trebled since 1880. There are \$100,000,000 of capital invested in the various branches of rubber manufacture in this country, and the value of the

RUBBER-TREES

yearly product is fully \$100,000,000, while 200,000 people depend upon it for their support. See also INDIA RUBBER.

Rubber-trees, the sources of caoutchouc (q.v.) or india-rubber (q.v.) are botanically various and widely distributed in the warmer parts of the world. They belong to the four allied groups *Moraceæ*, *Euphorbiaceæ*, *Artocarpaceæ*, and *Apocynaceæ*, but not all the members of these families yield caoutchouc, while a similar juice may be obtained from certain outside plants, but not in commercial quantities. This substance (latex) is one of those, like the "milk" of the milkweeds, and many others, which are elaborated in the green surface cells and conducted through the plant, for its nourishment, by the lactiferous canals. In the rubber plants they run just beneath the bark, and often carry the sticky juice in excess, so that "in the gigantic trunks of tropical fig-trees," as Kerner says, "the latex often wells up in large quantities from rifts in the bark which have arisen spontaneously, and thickens into long strings and ropes of india-rubber hanging down like a mantle." A rough test of whether a tree-juice has the true properties of caoutchouc is to rub some of it between the fingers until it exhibits the recognized elastic threads; inferior juices of other trees are sometimes mingled with it by native gatherers, as adulterants, and these may in some cases nearly ruin the whole package, by developing other qualities in coagulation, as, for instance, those of gutta-percha (q.v.).

The caoutchouc-yielding trees occur in all tropical regions, but are different botanically in each region. The principal commercial supply and the best is obtained from the valley of the Amazon, and is known to the trade as Pará rubber; but all other parts of northern South America ship it in large quantities. That which comes from the valleys of the Amazon and Orinoco (Brazil, Guiana, and Venezuela) is chiefly the product of the euphorbiaceous genus *Hevea*, and especially of *H. brasiliensis*, a tree often 60 feet in height, branching from the base, which, with two or three similar species, grows abundantly in the hot, steaming lowlands along the river courses; the juice is obtained by tapping the trees, by means of incisions in the bark in the evening, and collecting the deposition next morning. Each tree will yield about six ounces in three days, and then must be allowed to rest. The main resources in Guiana are the species *H. guayensis* and *paucifolia*, the former of which is called by the natives "cahoutchou." That exported from Maranhão is similar. The Ceará rubber is derived from a smaller euphorbiaceous tree (*Manihot glaziovii*), which grows over a large area in that part of Brazil, and is tapped when about two years old. The Pernambuco or Mangabeira rubber is the product of a small, drooping tree (*Hancornia speciosa*) of the family *Apocynaceæ*, which grows on the hills and yields the edible fruit "mangaba," for the sake of which it is frequently cultivated in orchards. This is a comparatively poor sort of rubber. Nearly all of the crude rubber above mentioned is exported to Europe, the United States deriving its supply mainly from Colombia, Ecuador, Central America, and Mexico. This is mainly the product of a tree (*Castilloa elastica*) of the family *Artocarpaceæ*, related to the breadfruit.

It is a lofty tree, with a trunk three feet or more in diameter, and large, hairy, oblong leaves, which grows in the rich soil of wet, low-lying, heavily forested valleys. With some allied species it flourishes from Mexico and Cuba to the mountains of Venezuela and the Andes, which separate it from the heveas of Brazil. It reaches its best size and condition in Panama and Nicaragua, where an average tree is expected to yield 20 gallons of milk, or about 40 pounds of crude rubber. Honduras rubber is good, but that from Guatemala is inferior.

The Asiatic supply comes from various parts in Assam (via Calcutta), and eastward to Borneo, and is chiefly produced by the rubber-fig (*Ficus elastica*). The trees may be tapped when 25 years old, and for 50 years afterward will yield 40 pounds of caoutchouc every three years. A large variety of other plants and trees in the Malayan and Papuan region yield rubber, some of which is excellent and of growing importance commercially, and everywhere the early rough and wasteful methods of obtaining the product are being corrected. It is also obtained in northern Australia, in Fiji, and in various neighboring islands. More than 100 different trees are known to give rubber-making juices in commercial quantities, while in a great many others, as lettuce, poppy, milkweed, and others, it is present in small quantities. The juice of the Brazilian *Hevea* trees is said to yield about 30 per cent of pure rubber; but a product of less than 15 per cent is not regarded as commercially profitable.

Africa is now the principal source of the rubber supply of the world next to South America. The bulk of that from the west coast and equatorial region is obtained from various climbing shrubs belonging to or allied to the apocynaceous genus *Vahea*, few of which are well known to botanists. In Liberia and somewhat elsewhere are rubber-bearing figs; and a large part of the extensive product of Madagascar and the Mozambique coast is derived from a *Walbergia*, species of which also give much of the caoutchouc received from the Malayan Islands.

Cultivation of Rubber Trees.—Attempts have been made in most countries, where suitable conditions prevail, to propagate the rubber trees in plantations of prescribed dimensions, and capable of rational supervision by experts, rendering the planter independent of native delinquencies and assuring annual crops of first quality for an indefinite number of years. It has been demonstrated that the rubber tree can produce, under proper management, a regular and increasing crop, for each year of its natural life, without being injured. The experiment of re-stocking the former rubber forests of the southern states of Mexico is now being carried on by American capitalists with prospects of success. Many thousands of acres of rubber lands have been purchased from the Mexican government, and are rapidly being developed in plantations. Progress has been retarded on account of lack of previous knowledge or precedent in the business, yet the difficulties seem to have been surmounted, and it is now demonstrated that the rubber tree can be artificially cultivated when conditions under which its growth is stimulated are understood. In Chiapas, the numerous river-bottoms afford the character of soil acquired,



PETER PAUL RUBENS.

RUBBLE WORK — RUBENS

favorable atmospheric conditions, and abundance of rain-fall. Covered with thick tropical forest growth, which it is necessary to clear, the rubber tree shoots, raised from seed in neighboring nurseries and about a foot high, are planted in the clearings to the number of 200 trees to the acre. But little further care is required. At six years of age the tree is tapped, yielding a small first crop. Hundreds of thousands of every age, from one to four years, are growing in apparent strength and luxuriance, with a prospect of affording an ever increasing supply of the crude product annually. The Central American rubber-tree will not flourish in swamps, though moisture is a prime requisite. The altitude it affects varies in different lands, preferably but little above sea-level, but in some localities 1,000, 1,500, or even 3,000 feet above tide water. The rubber-plant so commonly grown as an ornamental house-plant is the East Indian fig (*Ficus elastica*).

Rubble Work. See MASONRY.

Rubefacients, substances or agents which, when applied for some time to the skin, occasion a redness and increase of heat. When the irritant effect of any agent amounts to blistering, or causes discharge of pus or matter, the action is said to be vesicant or suppurative. All these agencies are included under the one term counter-irritants, the rubefacient action being the mildest of the three, and dependent generally upon the form and duration of the application; as, for instance, mustard or ammonia may be used so as to produce only the most transient redness, or may be made to cause blistering or suppuration. Among the most commonly used rubefacients are hot water, ammonia, mustard, oil of turpentine, powdered ginger, spirit of wine, camphor, and chloroform vapor.

Rubellite, the red or deep pink variety of tourmaline (q.v.); when transparent, valued as a gem.

Rubens, roo'bēnz, **Peter Paul**, Flemish painter: b. Siegen, western Germany, 29 June 1577; d. Antwerp 30 May 1640. He was the son of a person of good citizen family who had gone from Antwerp to Cologne on account of religious oppression, and who, while there, had become the steward of Anne, wife of William of Orange-Nassau, the famous liberator of the United Provinces. He was compelled to remove to Siegen, a small town, because of offenses committed, and it was not until his death in 1588 that the widow was able to return to Antwerp. There the boy studied in the Jesuit College and was page to a lady of rank. He studied art first with Tobias van der Haegt, and afterward with Adam van Noort, but his chief master was Otto van Veen (called Otto Vaenius). With this artist, who was court painter to the Regent of the Netherlands under Spain, the Infanta Isabella Clara Eugenia, Rubens remained from 1596 to 1600; and at the end of that period of time went to Italy. It is evident that he had the best introductions; and yet the young man's courteous manners and liberal training, as well as his great ability as a painter of portraits, must have made him welcome at once.

At Venice he met the famous and magnificent Duke of Mantua, Vincenzo Gonzaga, who at once employed him, sending him first to Rome, placing him near his own person at his own pal-

ace in Mantua, and sending him to Spain in 1603. While in Mantua he painted the famous triple altar-piece for the Prince's chapel; a work of which the greater part of the middle composition is in the Church of Saint Trinità in Mantua, one wing at Nancy in the Provincial Museum, and one at Antwerp. It was not until 1608 that he returned to the North, finding his mother dead on his arrival; and settled in Antwerp, his home from that time. It was then that he painted the first of the two wonderful pictures which are in the Cathedral of Antwerp, the 'Raising of the Cross'; and two years later, for the Company of the Arquebusers, its companion, the famous 'Descent from the Cross,' which is in itself a perfect embodiment of Rubens' art. He married, and now having property, both from his own inheritance and labor, and in right of his wife, bought land and built himself a house, of which drawings remain and in which he lived for 30 years in the fashion of a very wealthy burgher; though having, through the practice of his art, unusually close relations with the Infanta's court and the nobility, both Spanish and Flemish. It was in this capacity that he went to Spain on a mission for his patroness, the regent of the Netherlands, and her husband, the Archduke Albert of Austria, and was sent from Spain to England by the famous minister, Olivares. It is not to be forgotten that he was looked upon as a subject of the Spanish monarchy, and that in his capacity as a good Catholic he would have felt no objection to this view of the case, though he never took sides strongly against the Protestant rising of many of his countrymen. In England he was knighted by King Charles I. Finally in 1630, being then in his 54th year, he returned to Antwerp and married a second time. From this time onward his art employed him almost incessantly, in spite of a short intervention due to religious divisions between the northern and southern provinces; and his fame and popularity increased until his death in 1640 in Antwerp.

Few artists have had so varied a career, with so many other subjects of high interest to interfere with the peaceful pursuit of their art; and yet few artists have approached Rubens in the amount of artistic work done. This is to be accounted for in part by his extraordinary skill and success in assimilating the work of his many assistants (their names are those of men afterward famous in their art, chief among them Jordaens and Van Dyck); but partly also by the almost unexampled facility of work which he gained and which remains unique in the records of the art of painting. In his earlier days he copied great numbers of paintings by Italian masters, as was the custom then, and there can be no doubt that his facility and range were greatly increased by this practice. His work done after the age of 30 is uniformly wonderful for his power over all his materials, and all the different processes which enter into painting on a large scale. The fresh and rosy scheme of color which he adopted must have been natural to his instincts; original with him and not derived; moreover, his strong and intelligent drawing, though gained by practice in many schools, was still his own creation. His tendency to excess of action and to the appearance of violence, as

in the famous 'Fall of the Rebel Angels,' in Munich, and many similar works, does not seem to imply a headlong or self-forgetful mood; he seems to have been always master of himself, and his paintings were always popular (that is, in sympathy with his times), in style and management. He became in this way the typical artist of his epoch and the most admired master, the man chosen for great state undertakings in art as well as in diplomacy. It was in this capacity that he was employed by the Queen Dowager of France, widow of Henry IV., to decorate her palace of the Luxembourg in Paris, and the great paintings which are now in the new Hall of Rubens in the Louvre were prepared for that purpose. Studies for them are at Munich.

All the treatises on Flemish painting deal with Rubens, and the dictionaries of artists give him much space. The most important book devoted to him is that by Emile Michel, translated into English as 'Rubens, his Life, his Work, and his Time' (London 1899). This book is very richly illustrated. The collections of artists' biographies do not always contain Rubens' biography; but an excellent life of him by Charles W. Kett is included in the series called 'Illustrated Biographies of Great Artists' (1878-9). There are many books published in Belgium, either in French or in Flemish, which deal with the different stages in his remarkable career, and some of these are readily accessible. The essay on Rubens in 'Great Masters' by John La Farge (New York, 1904) is of great critical value. The 'Gazette des Beaux-Arts' has several important papers with elaborate illustrations.

RUSSELL STURGIS.

Rubicon, roo'bī-kōn, a river in Italy, of some celebrity in Roman history, Cæsar having by crossing this stream, at that time regarded as the northern boundary of Italy, finally committed himself to the civil war. Hence the phrase, "to pass the Rubicon," is to take the decisive step by which one commits himself to a hazardous enterprise. It is very doubtful under what modern name the Rubicon now exists, the honor being claimed by two streams—the Fiumicino and the Luso.

Rubidium, a rare metal discovered by Bunsen and Kirchhoff in 1860, by means of spectral analysis, in the residue obtained by evaporating a large quantity of the mineral water of Dürkheim, Germany. The metal and its salts exhibit two dark red lines in the blue part of the spectrum—hence the name, from the Latin *rubidus*, "dark red." Rubidium has the atomic weight 85.4, and the symbol Rb. It is a white, shining metal, having a specific gravity of 1.52; at ordinary temperatures—even so low, indeed, as -10° C.—it is soft as wax; it is easily oxidized; when thrown on water it decomposes that liquid with evolution of hydrogen, which takes fire because of the heat produced in the reaction. Rubidium forms one of the metals of the alkalis, being analogous in its properties with potassium and sodium; its compounds also closely resemble those of these metals; thus it forms a characteristic hydrate (RbHO), which is a white, solid substance, feeling unctuous to the touch, deliquescent in the air, and dissolving in water to form a strongly alkaline liquid. Rubidium forms one chloride (RbCl), bromide

(RbBr), and iodide (RbI), and in all its compounds comports itself in a manner precisely analogous with potassium and sodium.

Rubinstein, roo'bīn-stīn, **Anton Gregor**, Russian composer and pianist: b. Wechwotynetz 30 Nov. 1830; d. 20 Nov. 1894. His parents were Jewish and soon after his birth removed to Moscow. His mother, being a good musician, was his first teacher; he next studied with Villoing, a Frenchman, and at nine played in a concert at Moscow. He accompanied his teacher to Paris, where in 1840 he played before the most distinguished musicians. He was advised by Liszt to study in Germany and after a concert tour in England, Holland and elsewhere, he settled in Berlin to study theory under Dehn. He returned to Russia in 1848 settling in Saint Petersburg. In 1855 he was enabled to visit Germany again for study; here also he succeeded in finding publishers for his compositions, and made concert tours that extended to London and Paris. In 1858 he was again in Saint Petersburg, where he was appointed court pianist; in 1859 he became director of the Russian Music Society and in 1862 founded the Saint Petersburg Conservatory, and was director until 1867. He made concert tours in Europe in the following years and appeared in America in 1872-3. As a piano player he occupied the front rank; in perfection of technique he had few peers and was excelled by none. As a composer he was prolific, brilliant; but showed a lack of self-discipline which prevented his compositions from attaining the highest merit. He wrote operas, pianoforte pieces, orchestral scores and songs; his best known works being the Ocean Symphony and the pianoforte concertos in G major and D minor and the trio in B-flat. His operas, such as 'The Maccabees' (1875); 'Paradise Lost' (1875); 'Sulamith' (1883), have had but a partial success.

Ruble, roo'bl, or **Rouble**, a silver coin, the standard of money in Russia, containing 278 grains of fine silver, and equal to about 76 cents in American money. In actual circulation there is little but paper money, valued at from ten to twenty per cent below its nominal value. A ruble is divided into 100 copecks. Half and quarter rubles, and fifth, tenth, and twentieth parts of a ruble, are coined in silver; gold coins of the nominal value of three rubles (the imperial ducat) and five rubles (the demi-imperial) are also coined.

Ru'bric (Lat. *ruber*, red), was the name applied to those portions of old manuscripts and books which, for typographical embellishment or on account of their importance in the text, were printed in red ink. Often, as in the old monastic manuscripts, only initial letters in the paragraph were so treated. With the development of the copyist's art, however, rubricated manuscripts became ornate; the initial letter of every noun, perhaps, was rubricated, chapter headings, thumb-nail indexes, marginal comments, and in cases whole passages of the text were highly ornamented rubrics.

The use of the red letter text became common in the case of religious treatises, and so from the fact that certain rules and directions in prayer books, explanations and responses,

RUBUS — RÜCKER!

are printed in red ink. This is the case with the Roman missal, where the matins, lauds, beatifications, etc., are always in red; in the liturgy, where the directions for the performance of the service are in red. In the old Bibles the chapter heads were so treated. Modern typography discards such profuse use of colored ink and usually substitutes in its place type of a different face from the rest of the text, but the portions thus emphasized are still called rubrics.

Spanish custom has given another significance to the word, wherein it is meant to denote the flourish so common after Spanish signatures. This likewise results from the fact that the rubrics were the most conspicuous features of a page.

Ru'bus, a genus of plants of the order *Rosaceæ*, of which more than 1,500 species have been described, but probably only 200 are well marked, the remainder being intermediate forms. They are mostly natives of the northern hemisphere and are especially abundant in Europe. About 40 are indigenous to North America. They are mostly shrubs whose stems (canes) are biennial or annual, prickly, erect, curving, climbing or trailing. They have simple or compound alternate leaves, white or pink flowers usually in corymbs or racemes, followed generally by compound fruits consisting of many drupelets. In the blackberry the drupelets are united to the receptacle; in the raspberry they are not. Besides the raspberry, blackberry, and dewberry (qq.v.), many species are useful for food or ornament. Among the best known are the European bramble (*R. fruticosus*), wineberry (*R. phanicolasius*), flowering raspberry (*R. odoratus*), and the cloudberry, yellowberry, bake-apple berry (*R. chamæmorus*). The Rocky Mountain flowering raspberry (*R. deliciosus*), the brier rose, bridal rose or strawberry-raspberry (*R. rosæfolius*), and *R. crataegifolius* are well known ornamental species in shrubberies, etc. See BLACKBERRY, RASPBERRY, etc.

Ruby, the rich red, transparent variety of corundum. The name is sometimes used for other red gems (see RUBY SPINEL), and improperly for richly colored garnets, of the variety pyrope. The stones called Cape rubies and Arizona rubies are only fine pyropes, coming respectively from the South African diamond mines and from Arizona and New Mexico. (See PYROPE.) Siberian ruby is a term sometimes applied to gems of rubellite or red tourmaline (q.v.), and Brazilian ruby to the deeper shades of pink topaz, altered to that color by heat. The true rubies recently mined in the Cowee Valley, in North Carolina, have attracted much interest, being in some cases as fine as those from Burma; but they are mostly small, and it is not certain whether they will prove of real importance. They occur in a greatly decomposed igneous rock, in the same manner as the very similar crystals of sapphire from Yogo Gulch, Montana. The rubies of Burma, formerly spoken of as Pegu, are derived from a crystalline limestone. In these cases, and indeed generally, the gems are largely found in gravels and surface deposits formed from the decomposition of the

parent rocks. Like all the deeply-colored corundum gems, rubies are strongly dichroic, their color varying with the direction in which light traverses the crystal, whether transverse or parallel to the axis of the prism. The presence of microscopic cavities or of included crystals of extreme minuteness, disposed in a certain parallelism to the crystalline axes, produces the optical effect known as asterism, which is exhibited by the highly prized gems called star rubies (and star sapphires). In less amount or when irregularly distributed, the same causes produce defects known as "silk," and cloudiness. Many efforts have been made to produce the ruby by chemical means, and a dozen or more processes have been devised with greater or less success within the past 50 years, but with little practical result. Crystals have been obtained, of fine color, but mostly small, or in flat hexagonal plates too thin to furnish gems. Some years ago, larger pieces appeared in the market, that caused some concern from their close resemblance to natural rubies. The process was not made known, but was judged to be that discovered by Frémy and Feil, by fusing an aluminate of lead with silica. They were detectable by the microscope, which showed that they contained minute cavities that were rounded and bubble-like, while those in real rubies are angular and crystalline. The French "Syndicate of Diamonds and Precious Stones" decided that all such rubies must be sold as "artificial," under penalty of fraud.

Ruby Matrix is a name recently given to a beautiful combination of red or pink corundum with a bright green variety of hornblende (amphibolite) found at the Cullakenee corundum mine in Clay County, North Carolina; it has been proposed to use it as an ornamental stone, though the ruby-corundum is not transparent enough to cut gems.

Ruby Spinel, this mineral is an aluminate of magnesia. It crystallizes in octahedrons, with a hardness of 8, and a specific gravity of 3.5 to 3.7, usually of some shade of red, sometimes very rich, and transparent to translucent. Fine specimens make beautiful gems, known as spinel rubies, not readily distinguishable from true (corundum) rubies, though less hard, less dense, and less valuable. The historic "Black Prince" ruby, in the crown jewels of England, is believed to be a spinel. True rubies may also be distinguished from spinels by the dichroism which belongs to all the deeply colored corundum gems. Red spinel has several other varieties, with special names; it is called Balas ruby when the color is rich pink, rubicelle when it inclines toward an orange red, and almandine ruby when it tends toward a purplish. Spinel is a frequent associate of the true ruby, in Burma, Siam, Ceylon, etc. It usually occurs in crystalline limestones, though occasionally found in other metamorphic, and even in volcanic, rocks.

Ruby-throat. See HUMMING-BIRD.

Rückert, Friedrich fréd'rih rük'ért, German poet and Orientalist; b. Schweinfurt, Bavaria, 16 May 1788; d. Neuses, near Coburg, 31 Jan. 1866. His education was received at Heidelberg and at Würzburg. He first began

to write under the pseudonym of 'Freimund Raimar,' and 'Deutsche Gedichte' appeared with that signature. From 1826 to 1841 he occupied the chair of Oriental languages in the University of Erlangen, and while there was called to Berlin as privy councillor to Frederick IV. Here he also pursued his work as a philologist and poet. He retired to private life in 1848, becoming one of the most prolific writers of his day. He had a remarkable command of language and wrote almost every known form of verse. His original poems relating to the East are: 'Morgenländische Sagen und Geschichten' (1837); 'Rostem und Suhrah: eine Heldengeschichte' (1838); and 'Die Weisheit des Brahmanen' (1836-9). His adaptations include 'Die Verwandlungen des Abn Seid' of Hariri (1826); 'Nal und Damajanti' from the 'Mahabahrata' (1828); 'Amrilkais' (1843); and 'Hamasa' (1846). Among his other works are 'Saul und David' (1843); 'Liebesfrühling' (1844); and 'Lieder und Sprüche' (1866). Consult biographies by Beyer (1868-77); Konrad Fischer (1889); and F. Reuter, 'Rückert in Erlangen und Joseph Kopp' (1891).

Ruckstuhl, rük'stool, **Frederic Wellington**, American sculptor: b. Breitenbach, Alsace, 22 May 1853. At two he was brought to America by his parents who settled in Saint Louis, Mo. His art studies were begun in 1883 in Paris. His first exhibit, a life size nude figure called 'Evening,' won honorable mention in the Salon of 1888. His principal works are: a bronze figure 'Victory,' on the soldiers and sailors' monument at Jamaica, Long Island; the bronze 'Solon,' in the Library of Congress, Washington, D. C.; and the heads of Goethe, Franklin and Macaulay which form a part of the façade; and the heroic marbles 'Wisdom' and 'Force' above the New York Appellate Court building in Madison Square, New York.

Rudder, an oar or other instrument by which a ship is steered, being that part of the helm which consists of a piece of timber which enters the water, and is attached to the stern-post by hinges, on which it turns. The action of the rudder may be thus explained: While it remains in line with the keel, the force of the water gliding past the deadwood, or narrow portion of the stern, is equal on both sides of the rudder, and equilibrium is maintained; but if the rudder be forced to one side the pressure is taken off on the opposite side, while from acting at a less angle the water exercises an increased pressure on the side to which the rudder is turned. The effect is to force the stern round on the centre of gravity as a pivot, the ship's head, of course, turning to the same side as that on which the rudder is. When the head has sufficiently deviated from its former line the rudder is permitted to resume its straight position. In sailing on a wind, the rudder is kept permanently on one side to counteract the tendency to make leeway.

Rudder Fish, so named from being perceived usually in the wake of ships, following the movement of the rudder, and doubtless attracted by the refuse thrown overboard, is a small fish of the genus *Palinurus* allied to the mackerel family, very common in the Pacific and Atlantic oceans. *The Palinurus perci-*

formis, the rudder perch, or black pilot fish of the fishermen of Martha's Vineyard, attains a length of from nine to twelve inches, and is caught on the coasts of Massachusetts and New York, specimens having been obtained in Boston Harbor hovering around the sterns of vessels or keeping near such floating bodies as casks, planks, logs, and other flotsam. The back and top of the head is brownish with black blotches, the sides bluish-white with minute black dots, and the under parts lighter; the color of the young is a bright bronzed black, variegated with yellow circular spots obscure reddish hues and streaks of white and yellow lining the sides; there is a depression between the eyes which are protected by an overhanging bony ridge, and in front of the fleshy rays of the dorsal are eight short spines. The rudder fish belongs to the division of the scomberoids in which the first dorsal is composed of isolated spines connected by a low membrane, but unlike the scomberoids there are one or more spines in front of the anal fin.

Rudder Grange, a humorous story by Frank R. Stockton, which appeared serially in 1879 and was the first of the author's books to attract general attention. A slight thread of story suffices to connect a series of humorous episodes which result from the efforts of a young couple to establish themselves in a summer home at once desirable and inexpensive. In 'The Rudder Grangers Abroad' and 'Pomona's Travels' (1894), the principal figures in 'Rudder Grange' reappear.

Ruddiman, rüd'mān, **Thomas**, Scottish scholar: b. Raggel, Banffshire, October, 1674; d. Edinburgh 19 Jan. 1757. He was graduated at Aberdeen in 1694, revised and edited several works by Scottish authors, and to the famous poetical translation of Virgil's 'Æneid,' by Bishop Douglas, added a glossary, which brought him fame as a Latin scholar. In 1714 he published his 'Rudiments of the Latin Tongue,' a work which supplanted all previous Latin grammars in use in Scotland, and which he lived to see pass through 15 editions. In 1715 became a publisher and in this capacity edited and brought out many famous books, and in 1725 the first volume of his own 'Grammaticæ Latinæ Institutiones,' and an abridgement of the three volumes in 1740. Consult: Chambers, 'Life of Ruddiman' (1794); Chambers, 'Eminent Scotsmen.'

Ruddy Duck, a rather small, quick-diving handsome duck (*Erismatura rubida*), which is to be found throughout North and Central America, breeding in all suitable localities. It is related to several foreign sea-ducks, the Australian musk-duck, etc., but is itself confined to this continent. This duck is about 17 inches long, and chiefly tawny brown, the drake becoming glossy chestnut in full breeding plumage; considerably waved and dotted, and the lower parts mottled silver-white.

Rude, François, frän-swā rüd, French sculptor: b. Dijon 4 Jan. 1784; d. Paris 3 Nov. 1855. He was originally a blacksmith, but entered the Ecole des Beaux Arts in 1807 and was under the instruction of Cartellier. From 1815 to 1827 he worked at Brussels decorating the royal palace and subsequently settled at Paris, where his real artistic life began. His

chief works, which indicate a combination of antique simplicity with modern naturalism, are his 'Mercury' (1827), now in the Louvre; his 'Neapolitan Fisher Boy,' also in the Louvre; his 'Louis XIII.,' as a boy 1842; 'Sepulchral Monument of Cavaignac,' in the cemetery of Montmartre (1847); a 'Crucifixion' and the 'Maid of Orleans' (1852), both in the Louvre; 'Hebe' and 'Love as the Conqueror of the World,' in the museum at Dijon.

Rüdiger, Fedor Vasilievitch, Russian count and general: b. Courland, 1780; d. Carlsbad, Bohemia, 22 June 1856. He came of a noble Courland family, and entered the army when a youth. He saw active service in Germany and France during the campaigns of 1813-14 as a major-general; in 1828-29 served as a lieutenant-general in the war with Turkey; and after the suppression of the Polish rebellion, was promoted to be general of cavalry. Under Paskevitch he followed the campaign in Hungary in 1849, took an active part in the battles of Waitzen and Debreczin, and on Görgey's attempted retreat to Arad, pursued him and compelled his surrender at Világos. During Paskevitch's absence in the Crimea in 1854, Rüdiger was appointed lieutenant-governor of Poland.

Rudinger, Nicolaus, German physician and professor of anatomy; b. Rüdesheim, Prussia, 25 March 1832; d. Munich 23 Aug. 1896. After studies at the universities of Heidelberg and Giessen, he was graduated M.D. in 1855 at the latter university. He had exhibited a natural aptitude for anatomy and became assistant to his instructor Bischoff in the University of Munich, where in 1881 he was appointed Professor of Anatomy. In his lectures and his contributions to professional periodicals, photographic reproductions of his operations were notable features; from 1867 to 1870 he was co-editor of 'Monatsschrift für Ohrenheilkunde' and in 1877 of 'Beiträge zur Anthropologie und Urgeschichte Bayerns'; the most valuable of his numerous publications are 'Atlas des peripherischen Nerven-systems des menschlichen Körpers' (1872); 'Atlas des menschlichen Gehörorganes' (1875); and 'Topographisch-chirurgische Anatomie des Menschen' (1873-79).

Rudini, roo-dé'né, Antonio Starrabba di, MARQUIS, Italian statesman: b. Palermo, Sicily, 6 April 1839. In 1866 he became mayor of Palermo, and in 1867 a member of the Chamber of Deputies. He was appointed minister of the interior in the following year, but served only a few months. After the fall of the Menabrea cabinet he held no prominent office until in 1891, when, having become the head of the constitutional party, he succeeded Signor Crispi in the ministry of foreign affairs, and was made premier. In 1892 the premiership passed again to Crispi, but in 1896 Rudini returned to power as a result of Signor Crispi's disastrous Abyssinian policy. He continued in the premiership until 1898, when he resigned his office. His renewal of the Triple Alliance and conclusion of peace with Abyssinia were the most important of his executive acts, while his continued yielding to the pressure of the radical party, and failure to weld the conservative elements of the Italian parliament are quoted against his administration.

Rudler, Frederick William, English scientist, educator, and writer: b. London 8 July 1841. A predilection for scientific study and research led to an early appointment as assistant in the Museum of Practical Geology in 1861. In 1870 he was elected assistant secretary to the Ethnological Society, and from 1876 to 1879 was professor of natural science in the University College of Wales, an appointment he resigned on being made curator of the museum. He was one of the lecturers of the London Society for the Extension of University Teaching; in 1880 was president of the anthropological department of the British Association; and in 1889 president of the Geologists' Association. He was appointed director of the Anthropological Institute, and editor of its 'Journal,' was co-editor of Ure's 'Dictionary of Arts,' and as a prolific contributor of scientific subjects to encyclopedias and technical periodicals is well-known.

Rudolf I., roo'dölf, emperor of Germany, founder of the imperial house of Austria: b. 1 May 1218; d. Gernersheim 15 July 1291. He was the eldest son of Albert IV., count of Hapsburg and landgrave of Alsace, was brought up in the court and camp of the Emperor Frederick II.; and on the death of his father succeeded to lands of a very moderate extent, which, in the spirit of the times, he sought to augment by military enterprises. He gained some territory by his marriage in 1245 and more by his frequent military aggressions. In 1273, while encamped before the walls of Basel, he received the unexpected intelligence that he was elected king of the Romans, and emperor, in preference to Alphonso, king of Castile, and Ottokar, king of Bohemia. His confirmation was not attained without some difficulty, however. Pope Gregory X. induced the King of Castile to withdraw his pretensions, but the King of Bohemia, at that time one of the powerful princes in Europe, persisted in his opposition, and a war ensued, in which he was defeated and compelled to sue for peace, and agree to pay homage. He broke the treaty in 1277, but the following year was defeated a second time, and slain. The Diet of Augsburg in 1282 formally conferred Austria, Styria, Carinthia, and Carinola on Rudolf's two sons, Albrecht and Rudolf, as a joint inheritance. He restored peace and order to Germany, and wisely put down the private fortresses, which served as a retreat to banditti and to ferocious nobles. For these and other eminent services in the same spirit he obtained the title of 'a living law,' and was regarded as a second founder of the German Empire. He asked the Diet at Frankfort to secure the imperial throne to his son Albrecht, but the electors were jealous of the powerful family and their refusal caused such mortification to the aged emperor that he did not long survive. Consult: Kopp, 'König Rudolf und seine Zeit' (1845-9, continued by Busson 1871); Hein, 'Rudolf von Habsburg' (1874); Schulte, 'Geschichte der Habsburger' (1887); Zisterer, 'Gregory X. und Rudolf von Habsburg' (1891).

Rudolf II., emperor of Austria: b. Vienna 18 July 1552; d. Prague 20 Jan. 1612. He was educated in Spain, and before the death of his father, Maximilian II., was crowned king of Hungary in 1572; king of Bohemia in 1575, the same year being also crowned at Ratisbon

king of the Romans. He succeeded to the Austrian throne 12 Oct. 1576. His disposition was mild and his tastes inclined toward literature rather than toward government. Early in his reign he began to impose restrictions upon the holding of public offices by Protestants and in some districts civil war resulted. The western parts of the empire were enabled to overcome the designs of the king, and by 1603 the Protestants formed an offensive and defensive alliance at Heidelberg to maintain their civil and religious liberties. In Austria, Bohemia and Hungary, however, the Protestant religion was for a time practically suppressed. The Turks made constant inroads in the east and in 1596 Mahomet invaded Hungary, captured Erlau and defeated the Austrians under Archduke Maximilian, though he ceased his incursions at this point. In 1608 Rudolf's brother Matthias, who had made a treaty with the Turks and pacified the disaffected Hungarians, compelled Rudolf to acknowledge him king of Hungary and governor of Austria and Moravia. With this confirmation of Matthias' power the states of Austria regained the religious privileges they had enjoyed under Maximilian. In 1611 Rudolf was formally deposed and Matthias succeeded him. He was the patron of Kepler and Tycho Brahe and the astronomical calculations produced by these two are known as the "Rudolphine Tables." Consult: Gendely, 'Rudolph II. und seine Zeit' (1863-5).

Rue, a perennial (*Ruta graveolens*), wild in the Mediterranean regions, but also cultivated. Its stems are about two feet high, bearing alternate decompound bluish green leaves, pellucid-dotted, with an acrid juice and bitter taste; and corymbs of yellowish green small four-merous flowers, with crimped petals. Rue has been employed medicinally on account of its antispasmodic and stimulant properties, and was also used in folk medicine as a disinfectant, probably because of its strong and disagreeable odor and taste, which, however, did not prevent its use as salad. Rue also entered largely into magic rites, and witch-lore. Early missionaries in England were said to have sprinkled water from brushes made of rue, whence the name referred to by Ophelia. "There's rue for you . . . We may call it, herb of grace o' Sundays," and Perdita speaks of it, with rosemary, as one of the flowers for remembrance.

Ruff, a sandpiper (*Machetes pugnax*) of the northern parts of the Old World, the female of which is called "reeve." It is about 10 inches long, and the bill $1\frac{1}{4}$; above it is varied with black, rufous, and gray, arranged in oblique bands on the scapulars and tertiaries, and whitish below; primaries dark brown, with green reflections above and with inner webs finely mottled toward the base; the tail transversely barred; sides of rump white, bill brown, and legs yellow. The males in spring have the feathers of the neck developed into a kind of ruff, whence the common name, and the face is covered with reddish papillæ; they fight during the breeding season, unlike most wading birds; they are also polygamous, and larger than the females, in these respects seeming to form one of the links between wading and gallinaceous birds. The colors of the ruff vary exceedingly, and no two are precisely similar. They

are natives of northern Europe and Asia, migrating southward during winter, and they are found chiefly in flocks, in marshy districts; they feed at night, on worms, insects, and larvæ; the nest is made of coarse grass, and is placed in a hollow of the ground; the eggs are 4 or 5, pointed, green, with brown specks. Their flesh is highly esteemed for the table; they are taken alive in nets, and are fattened for market on bread and milk and boiled wheat, in a dark place to prevent their fighting; great numbers are sent from Holland to London.

Ruffed Grouse. See GROUSE.

Ruffed Lemur. See LEMUR.

Ruffin, Edmund, American agriculturist: b. Prince George County, Va., 5 Jan. 1794; d. near Danville, Va., 15 June 1865. He was educated at William and Mary College, served in the Virginia legislature, was for many years president of the Virginia Agricultural Society, and in 1833-42 editor of the 'Farmer's Register.' He was an ardent state-rights man, and as member of the Palmetto Guard of South Carolina fired the first shot on Fort Sumter in 1861. He committed suicide because of his unwillingness to live under the United States government. He published: 'Essay on Agricultural Education' (1833); 'Anticipations of the Future to Serve as Lessons for the Present Time' (1860); edited William Byrd's 'Westover Manuscripts' (1841); etc.

Rugby, England, a market town of Warwickshire, 81 miles by rail northwest of London. It is picturesquely situated on an eminence south of the Avon, and is celebrated for its public school. (see RUGBY SCHOOL). The parish church recently restored, the modern municipal offices, and the free public library are other noteworthy features.

Rugby, Tenn., the place in Morgan County, about 140 miles north of Chattanooga, where Thomas Hughes (q.v.) and others from England established a colony in 1880. They purchased a large tract of land, laid out a town, divided the remaining portion into farms and parks, and established several industries. It is in a rich mining and agricultural region on the Cumberland plateau. The settlement proved a failure; but the place is now a health resort.

Rugby School, a famous English public school founded in 1567 by Lawrence Sheriff, who bequeathed for its support property in Manchester Square, London. Until the second quarter of the 19th century its importance was local in character, however, but under the headmastership of Arnold (q.v.) 1828-42, it became one of the greatest schools of England,—to be ranked with Westminster, Eton, and Harrow. Among famous headmasters who followed Arnold are Archbishop Tait, the late Dean Bradley of Westminster, the late Archbishop Temple, and John Percival, now bishop of Hereford, who was succeeded in 1895 by Rev. Herbert Armitage James, the present headmaster. The roll of distinguished Rugby scholars is a long one; among them may be mentioned Matthew Arnold, Dean Stanley, Landor, Clough, Thomas Hughes, author of 'Tom Brown's School Days,' Dean Vaughan and Lord Derby. Under the mastership of Dr. Temple (1857-69) the chapel was rebuilt, a gymnasium erected, and other

new buildings added, while under Dr. Jex-Blake (1874-87) still more building was carried on and Rugby is to-day particularly modern in the character of its buildings, which are Elizabethan in style, and in its appointments generally. Consult: Goulburn, 'The Book of Rugby School' (1856); Hughes, 'Tom Brown's School Days' (1857); 'Life of Thomas Arnold' (1860); Bloxam and Payne-Smith, 'Rugby: its School and Neighborhood' (1889); Rouse, 'History of Rugby School' (1898).

Ruge, roo'gě, **Arnold**, German socialist: b. Bergen, Prussia, 13 Sept. 1802; d. Brighton, England, 31 Dec. 1880. He was educated at Heidelberg, Jena, and the University of Halle, where in 1830 he became a professor. His first literary production was a translation of Sophocles' 'Œdipus in Kolonos' (1830). He was later identified with the founding of the 'Hallesche Jahrbücher' and became known as an advocate of radical doctrines. In 1843 he went to Paris where he was associated with Karl Marx, and there published his 'Zwei Jahre in Paris.' In 1847 he started a journal, 'Die Reform,' in Berlin. Accused of complicity in the revolution of 1848, he fled to England. He was there identified with Mazzini and Ledru-Rollin in their efforts to organize a democratic league for the establishment of political equality throughout the world. The movement to unite the provinces of Germany in 1855-70 was strengthened by his sympathy, and his services in this cause were recognized by the German empire. He published: 'Political Pictures' (1848); 'Our System' (1850); 'In Former Times' (1862-7); and a 'Manifesto of the German People' (1866).

Rügen, rü'gēn, an island belonging to Germany; in the Baltic Sea; area, 377 square miles. The coast has many indentations; on the northeast the island terminates in a chalk cliff, nearly perpendicular and about 400 feet above the water. Peculiar shaped boulders are found on different parts of the island. According to Tacitus, the ancient Germanic goddess Hertha (Earth) was worshipped here at Hertha Lake. The soil is fertile; agriculture, stock-raising, and fishing are the chief occupations. The coast villages are popular sea-bathing resorts. Bergen is the capital. Pop. 46,800.

Rugendas, roo'gēn-dās, **Georg Philipp**, German painter: b. Augsburg, 1666; d. there 1742. His right hand becoming disabled he painted and engraved with his left. He exposed himself to the fire and carnage at Augsburg that he might delineate the scene.

Ruger, roo'gēr, **Thomas Howard**, American army officer: b. Lima, N. Y., 2 April 1833; d. Stamford, Conn., 3 June 1907. He was graduated from West Point in 1854, studied law, and in 1855-6. was engaged in practice. At the outbreak of the Civil War he was appointed lieutenant-colonel and was prominent in numerous engagements. He suppressed the draft riots in New York in 1863, was in command of a division at Gettysburg, served under General Sherman, and in 1864 was brevetted major-general of volunteers. He was mustered out of the volunteer service in 1866, and in that year was appointed colonel in the regular army. In 1868 he was military governor of Georgia, superintendent at West Point in 1871-6, and in 1876-8 was in command of the Department of

the South. He was promoted major-general in 1895, and in 1897 was retired.

Ruggles, rüg'lz, **Timothy**, American lawyer, politician, and loyalist: b. Rochester, Mass., 20 Oct. 1711; d. Wilmot, Nova Scotia, 4 Aug. 1795. He was graduated from Harvard in 1732, represented Rochester in the general court in 1736, opened a law office at Sandwich, Barnstable County, and was connected with many cases of local importance in Plymouth, Bristol, and Barnstable counties. Subsequently he removed to Hardwick. In 1755 he was second in command to Sir William Johnson at the battle of Lake George, in 1756, was made judge of the court of common pleas of Worcester County, and represented Hardwick in the general court. In 1762-3 he was speaker of the house, and from 1762 until the Revolution chief justice of the court of common pleas in Worcester County. He served with distinction in 1759-60 in the expeditions against Quebec and Montreal, and in recognition received the sinecure post of surveyor-general of the King's forests. He was a delegate in 1765 to the Stamp-act congress at New York and was elected its president. Upon his refusal to forward to Great Britain the addresses and petitions passed by the congress, he was reprimanded by the general court. From that time he was identified with the royalist cause. In 1774 he was made mandamus councillor, and in consequence was forced for safety to flee from Hardwick to Boston, then garrisoned by the British. He made some efforts to recruit a loyalist corps, and in 1779, on the departure of the British troops, went with them to Nova Scotia, where he became a proprietor of the town of Digby. He was a scholar and wit, and an excellent, though aggressive, pleader.

Rugs, Oriental. *History.*—The origin of the floor coverings, popularly known as Oriental rugs, is a matter of tradition, and therefore purely suppositional, for the fragmentary record of the ancients, on this subject, is casual and exceedingly incomplete.

Undoubtedly, however, along with the slow evolution of human progress, rugs, in some form, filled their proper places in the scant household furniture of primitive man.

An old Hebraic tradition ascribes distinction of skillful spinning of wool and weaving of cloth, to Naamah, daughter of Lamech, who was a near descendent of Adam, thus placing the handicraft of weaving close to the Biblical account of the beginning of the human race.

It is not at all improbable that Egypt, the successful producer of many useful industries of the ancients, improved the crude handwork of her predecessors, for we possess records of rugs on her rock-cut tombs, carvings, and monuments, some of which date as early as twenty-seven centuries B. C.

Other wall paintings, stone carvings, and monuments in the Euphrates Valley indicate clearly that the dwellers of these regions such as Chaldeans, Assyrians, Armenians, and Persians were the first to use the rug for floor coverings, wall hangings, tomb coverings, awnings, and for devotional purposes; and that afterwards the conquerors of these peoples, the Greeks, Romans, Turks, Turkomans, and Saracens, took up the industry and spread its popularity throughout their dominions.

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Ancient Authorities.—Besides Biblical writers, among the ancients who mention rugs and carpets, are included Diodorus, Ebers, Homer, Plautus, Horace, Pliny, Josephus, Arrian, and almost all writers of note; but as stated above, not one of these famous men imparts definite information concerning the industry.

Introduced into Europe.—While very little is known concerning the rugs of the ancients, our knowledge takes definite shape and grows in volume along with the triumphant march of the religion of Mohammed, the great prophet of Arabia, whose enthusiastic followers went from victory to victory, till they threatened the very existence of mediæval Europe.

Rug making was introduced to Europe by the Moors, whose palaces and mosques in Cordova, Granada, and Castilia, were adorned with magnificent carpets; and later, when the Crusaders returned from their wars against the followers of the Crescent, they brought back with them not only a violent desire for Oriental luxuries, but a knowledge of Oriental handicraft, most important among which were rugs and carpets.

Thus, in about the latter part of the 13th century A. D., rugs were introduced in Europe and England as objects of wonderful ingenuity and of great value.

From that time interest in rugs from the Orient has constantly increased among all civilized people's till to-day they rule supreme as the most desirable and most artistic floor coverings in the world.

Process of Making.—The general process of rug making of to-day is as old as when it was described first by ancient writers. To-day rugs are made by the descendants of first rug makers in the same crude and primitive fashion. Nothing has been changed—nothing could be changed—for the process is so absurdly rudimentary that it precludes improvement. In the use of material, dyes, and implements there has been no alteration made, since before the period when Cleopatra was presented to Cæsar wrapped in a magnificent carpet.

(a) The Loom, more properly the frame, on which a rug is to be made, consists of two perpendicular poles (not infrequently two trees) driven in the ground at a desired distance from each other; to these are fastened two horizontal bars, one on top, the other at the bottom of the poles.

(b) Tools.—It is an absurdity to dignify by the name of "tools" a crude wooden or iron comb, and a pair of common shears, which about conclude the description of the "machinery" of rug making; no other implement is required for the production of the finest Oriental rug.

(c) The Warp.—The warp of a rug consists of desired thickness of thread or twine in wool, cotton, linen, hemp, goats' or camels' hair, and in some cases silk, which is stretched, back and front, upon the horizontal bars of the frame, at even spaces, to form the foundation of the rug.

(d) The Weft.—Before actual tying of the colored yarn to the warp, the maker weaves the salvage or diaper, beginning at the bottom of the warp. To do this he introduces a shoot of hemp or wool or cotton by means of a treadle and crossing the warp, which is

repeated till a desired width is woven; then he beats this down with his comb. This cross warp, introduced after each row of the knotted yarn, is called the weft of the rug, which very often determines the fineness and the strength of the finished article.

(e) The Knotting.—All Oriental rugs are actually tied to the warp—tuft by tuft separately—these are tied by hand; so, properly speaking, rugs are not woven, but built, tied, knotted. This part of the process requires great skill, accuracy, and more than Job-like patience.

Two ways of knotting are employed throughout the Orient in rug making: (1) The Persian (Sehna) knotting; (2) the Turkish (Ghiordéz) knotting. The Persian knotting consists in winding the two ends of the yarn around two separate threads of the warp, and bringing the two ends of the yarn to the surface from between each space of the warp. The Turkish knotting consists in winding the two ends of the yarn round two separate threads of the warp alternately and bringing the two ends to the surface between every two threads.

The Yarn.—Almost every woolly animal and hairy beast contributes its quota to the floor covering of the Orient, and cotton hemp and linen, in some cases silk, and even gold and silver threads are used to bind together the "flowing lines of beauty" of the rug.

In the inaccessible fastness of Kirman, the vast mountain chains of Kurdistan and in the enchanting valleys of Shiraz and Kashmere and Euphrates, countless flocks of sheep yield the finest wool; not to mention the soft and downy wool raised in the shadow of Ararat in Armenia, and under the shelter of Demavend in Persia; and the camel of Arabia, and the goat of Angora and of Bokhara, vie with each other in their contribution of marvelous hair, which is transformed into bits of scintillating gems in the hands of the skillful artist of the Orient.

The wool, after being sheared, is washed thoroughly, and sorted, and carded upon crude wooden or iron rakes, and afterwards spun very much after Mr. James Bryce's description: "Each, [spinner] like the fates of Catullus, bore a distaff in her hand, with a lump of wool upon her wrist, and this they plied as they drove their flocks before them." And, when thus the wool is spun, it is made into skeins ready for the dyers' vet.

The Dyes.—To dye the yarn is a separate industry in the Orient, and the skillful dyer holds equal rank with the "dervish" and the conjurer—for, to extract beautiful dyes from animals, insects, trees, plants, roots, herbs, seeds, barks, flowers, berries, fruit, and from every imaginable thing yielding color, is no less wonderful than the feats of a howling "dervish" or the mysterious exorcism of the magician's wand.

From the old Tyrian purple, which adorned the royal vestments of the ancients, and which is a lost dye to-day, to the ordinary red madder of Asia-Minor, the extracting of dyes and coloring the yarn is a long drawn process in an exceedingly primitive manner.

The usual method is to boil in water the ingredients of a given color, with their mordant of vinegar or some other acid, in an earthen pot, till the desired constancy is

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reached, every little while the dyer smelling and tasting the liquid. Afterwards the yarn in skeins is dipped in this preparation, till the required shade is obtained, then withdrawn and dried in the sun. Often the dyed yarn is exposed to the influence of the elements for weeks and weeks, till in the laboratory of nature the dye becomes a permanent portion of the wool, and remains thus as long as the material exists.

There are some dyes which require no such treatment, others, which must be produced in an entirely different manner, but in each case the skilled dyer knows just how to obtain best results; and left to his own resources, given his own time, he usually accomplishes the desired end.

Ornamentation.—Taking a wide survey, from the sea of Marmora at the West, to the Yellow Sea at the East, Oriental rugs may be divided into two general classes, according to ornamentation: (a) geometrical; (b) floral. The development of geometrical ornamentation is attributed to the Turanian races occupying the northeastern portions of Asia, most of whose rugs bear the stamp of a more primitive type, which lead us to believe that they are more closely related to the rugs of pre-historic times. The design, popularly known as the Swastika or filfot cross is believed to constitute the basic pattern of all geometrical ornamentation in rugs—indeed, some authorities go further in the assertion that the Swastika was the first design used for ornamentation by the human race.

The floral ornamentation, a later and more intricate method, was adopted by the Aryan races, and carried to its highest development by people inhabiting the country lying between the Caspian Sea and the Persian Gulf.

The typical design of floral ornamentation is the 'flower and knop,' a conventionalized resemblance to the Egyptian lotus or the tree of life of the ancients.

An endless variety of patterns of both classes appear on rugs; they are mixed and intermingled so hopelessly, that a rigid classification according to ornamentation is almost impossible.

Purely floral patterns, such as representations of leaves, trees, blossoms, rosettes, palmettes, are strewn over or under squares, circles, stars, octagons, medallions, and various forms of the Swastika in a manner so blended, that a classification of rugs according to ornamentation resolves itself to an unsolvable riddle.

Symbolism.—It is stated by enthusiastic writers on Oriental rugs, that a fascinating array of symbolism lies beyond those charming patterns.

The rug itself typifies the universe, and its various designs the ever-changing phenomena of life. The principal coloring of the field of the rug, if red, signifies life, victory; if blue, royalty; if white, purity; if green, devotion; if black, evil; if yellow, nobility; and so on to the end.

In patterns, the Swastika signifies auspiciousness, good luck; the flower and knop, fortune, life everlasting; the circle, immortality; the star, the Star of Bethlehem; the triangle, the charm of Solomon; the square, "the square deal"; the comb, cleanliness, etc.

Among vegetation, the rose typifies love; the lily, purity; the scarlet tulip of Babylon, passion; the blossom, innocence; the fruit, fecundity; the tree, abundance, etc.

And the star of six points represents Allah!

It is reasonable to ask, however, that this endless chain of designs having come to us from the mythological past, where the light of knowledge fades in the mist of tradition, who can say positively that a certain design typifies a certain idea—and that is not "one man's guess as good as another's"?

The greatest charm of Oriental rugs lies in the simplicity of construction, in the impress of individuality of effort, and in the incomprehensible mystery of design. The manner of their making is primitive; the materials used are all home made, and the ornamentations in odd lines, angles, squares, or in grotesque likenesses of 'fish, flesh, and fowl,' the original meanings of which are forever buried in the first ages of mankind—these, and the wonder of their marvellous colorings, the secret of many being still secret and many another being entirely lost, add to the teasing witchery of the Oriental rugs.

Names.—To the uninitiated, of the many unsatisfactory peculiarities concerning the subject, the naming of Oriental rugs is the most perplexing. There is no fixed rule that would classify clearly the enormously diversified output of rugs within the vast area of about three-quarters of the continent of Asia. There are, however, six recognized geographical divisions, which include about all Oriental rugs of our days, namely: (1) Persian rugs; (2) Turkish rugs; (3) Caucasian rugs; (4) Turkoman rugs; (5) Indian rugs; (6) Chinese rugs.

Persian Rugs.—Persia, the home of floral ornamentation, and the most marvellous exponent of textile productions of the Orient, stands on the pinnacle of fame by unanimous consent. She attained this enviable position especially during the benign reign of Shah Abbas, in the 16th and 17th centuries, under whose wise encouragement she reached the golden age of the rug industry.

The Ispahan rugs, made under Shah Abbas, with their gorgeous field of "Ispahan red," decorated in tulip, rose, lotus, iris floriated, fastened together in chiselled tracery of refined meandering lines and angles at once puzzling and fascinating, established a new epoch of the rug industry, never equalled since.

And a somewhat similar pattern of the Ispahan having been evolved, the glossery of Persian rugs was enriched by another famous type of pattern called the "Shah Abbas," after the most honored monarch of Persia. The Ispahan rug, as a class, stands alone, and its specie is extinct, only a very few perfect specimens and many fragments being jealously preserved in museums or in private collections.

Persians, who ought to know best, divide their rugs into the following groups according to ornamentation mostly, which is different from the accepted division in common use abroad: (a) Kirman; (b) Herati; (c) Iran; (d) Hamadan; (e) Kurdistan.

(a) The Kirman group is subdivided into the following celebrated specimens: (1) Kashan; (2) Kirman or Kirmanshah; (3) Saruk; (4) Tabriz. The chief characteristics

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of this group lie in their extreme fineness of texture, brilliance of coloring, and purely floral ornamentation, which is carried to its highest perfection.

Mostly of modern construction, but copies of some old forms, with floriated medallions or panels or scrolls, replete with vases of flowers, and representations of birds or beasts, these rugs show the scintillating splendor of jewels in textile art; and they command high prices on the American market.

(b) The Herati group includes: (1) Meshed; (2) Khorassan; (3) Shah Abbas; (4) Feraghan; (5) Joshaghan; (6) Youraghan.

To the heart of a true son of old Iran, this group of rugs is the most precious of all, for here are preserved the glorious traditions of his forefathers; here, the holiest shrine of his faith; here, the revered name of his most illustrious Shah, and here, the true splendor of his matchless artistry. The chief excellency of this group is in the development of the leaf pattern; be it the palm leaf, the rose leaf, the lotus leaf, or the so-called river-loop design; it fills a very prominent part of ornamentation either in a curled position as in the Feraghan, or spread out on borders, corners, and medallions as in the Meshed and Khorassan, or in groups and clusters of splendid tracery as in the Shah Abbas.

(c) The Iran groups contains the following popular specimens: (1) Teheran; (2) Mihr; (3) Saraband; (4) Shiraz.

Most worthy of mention, and very much admired by all Orientals, are the Saraband and Shiraz rugs, besides the Mihr, which really is the finest grade of Saraband.

The characterizing peculiarity of these, especially of the Mihr and Saraband, is the palm leaf pattern, row upon row, on a field of red or blue and seldom ivory, each row of palm leaf facing in an opposite direction.

In the Shiraz rugs the palm leaf design, if employed at all, is used without regard to regularity or size. The Shiraz rugs show an utter disregard to conventional patterns, therefore, they are among the most interesting rugs of the Orient. Often medallions run through the centre which are decorated with flowers, leaf patterns, birds, and animals, much after the style of Kirmans. But the distinguishing points are: the salvages overcast in two or more colors with tassels here and there, and the two ends finished with pretty needlework patterns.

In the Teheran the patterns may or may not show the palm, but they are kindred rugs in all other respects.

(d) The Heriz group contains: (1) Ardebil; (2) Hamadan; (3) Bakhshaish; (4) Gorovan; (5) Serapi.

In these rugs, the medallion with its various modifications is carried out in a most pronounced fashion; especially in the Gorovan and Serapi, where the medallion stands out in barbaric outline upon a field of red, white, blue, green, or brown hues of great brilliancy.

In the Heriz and Hamadan, the undyed hair of camel plays a prominent part, often covering the whole rug, decorated with rosettes, medallions, pendants, and heavy tracteries, all interwoven in bold contrasts. In the Ardebil and Bakhshaish and the Heriz proper, these striking contrasts are entirely eliminated, indeed,

these show such superb mellowness of coloring, graceful lineations and superior floriations, that they bespeak of times of the long ago.

(e) In the Kurdistan group are included the following specimens: (1) Sehna; (2) Bijar; (3) Lullé.

It would seem that the Sehna rug should not fall under this heading, for there is no similarity of style or texture to the Kurdistan; but the people of Persia class this rug as a Kurdistan.

The Sehna, so far as fineness of texture is concerned, belongs to the Kirman group, and not infrequently surpasses even the best Kashan texture of the Kirman group. Hundreds of knots are crowded in a space of one square inch with shortest cut yarn, till it becomes almost beyond belief that human fingers are capable to produce such a fabric.

The Sehna rug shows no reckless disregard to design or color; whether rosettes or palm patterns or medallions, every line is clear cut, every curve masterly rounded, and every color faithfully reproduced. The Sehna is the thinnest rug made in the Orient.

In strongest contrast to the Sehna are the Bijar and Lullé of the Kurdistan; they recognize no established pattern; accept no school of coloring, and follow no rule of texture.

Generally thick and heavy in texture, employing all the standard Persian designs without regard to fitness or uniformity of position on lustrous fields of rich and deep coloring; whether coarse or fine, heavy or light, these rugs compel admiration by reason of their extraordinary solidity.

Turkish Rugs.—In the Turkish empire live many races, peoples, and religions, which are not at all affiliated with one another—remnant nations of Syria, Babylonia, Armenia—Chaldea, Greece, Hebrew, etc.—consequently, the textile productions of this region are somewhat mixed and rather difficult to classify. It appears, however, that the Turkish detached mode of ornamentation repeated on some parts of rugs, and the generous use of both floral and geometrical designs usually seen in all Turkish products, would give them a certain distinction; add to this the very popular pattern found in the praying rugs, and Turkish rugs become an individual class in the family of Oriental rugs.

Moreover, most Turkish rugs are coarser than Persians, their pile being longer, looser, thicker, and softer.

The people of Turkey divide their rugs into the following principle specimens: (a) Gheordez (Yordez); (b) Koulah; (c) Ladik; (d) Melez; (e) Berghama; (f) Koniah; (g) Kir-Shehir; (h) Kutahia; (i) Mousul; (j) Kurd; (k) Yuruk; (l) Anatolian.

(a) In conception of design, execution of workmanship, and combination of coloring, the Gheordez stands first in all Turkish rugs, and is most highly praised by Turk, Greek, Armenian, European, and American alike.

Usually made of praying-rug design, the field has a solid coloring of ivory, blue, red, sometimes green, with the niche or dome resting on two ornamented columns; but at times the columns being absent, the dome is supported by highly conventionalized patterns of the tree of life.

A wide border, generally of the same color-

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ing as of the field, is decorated with flowers and configurations so clustered as to form a superb square, which is repeated on the four sides of the rug, and frequently on the panels, over and under the enclosure of the praying niche pattern.

Two or several narrow borders in detached patterns surround the principal border; and on the two upper corners filling the trigonal spaces of the praying dome, are distributed figures bearing a resemblance to the main border. Often a bejeweled lamp hangs down from the center of the dome.

The colorings of the Gheordez of old are impossible to describe appropriately, and it might be added with truth, equally impossible to reproduce in paint.

(b), (c), (d) Koulah, Ladik, Melez, these three, are kindred rugs to the Gheordez, but they are not equal to the latter.

In Koulah, the praying dome is often indented or otherwise misshapen, and the field, instead a solid color, is decorated with patterns. It is marked also with several narrow stripes, for border, with startling contrast of colors.

The Ladik may be called a better rug than the Koulah, for it often possesses beautifully subdued greens, deep reds, blues, all blended attractively.

The Melez might be named as a twin sister to the Ladik, for it has all her characteristics, and only the trained eye can properly distinguish between them.

(e), (f) Berghama and Koniah rugs generally show medallion designs and a field well covered with geometrical patterns; they have also wide attractive borders covered with floral decorations. In size these rugs are made nearer square than other Turkish productions, with a heavy, silky pile and very attractive colorings.

(g) The Kir-Shehir products, praying-rug design or other, generally small rugs possess much resemblance to Ladik and Melez, they are, however, coarser rugs with brighter colorings and with unpleasant contrasts.

(h) Kutahia or Kutais, is a longer rug than the foregoing specimens with no special characteristic in design or coloring. A satisfactory rug usually, with silky surface, pleasing design and fine coloring.

(i), (j), (k) Mousul, Kurd, Yuruk. Strictly, these three grades do not belong to the Turkish family of rugs, yet neither could they be classified under the Persian group, and since the provinces in which they are made fall under Turkish rule it is proper to call them Turkish.

In design, in texture, in workmanship, these are the 'heavy-weights' in rugs. There is coarseness, boldness, and a wild strength in these rugs, which indicates the mountain, the desert, and the ravine; usually made of good wool and of good colorings (often exceptionally good), they lack the refinement of a Herati or the exquisiteness of a Gheordez.

The Kurd and the Yuruk especially, show an utter disregard to regularity of design or texture; sometimes long and shaggy like the matted wool of a sheep, they defy any accepted school of rug making.

(1) Anatolian.—There are several other grades made in Turkey, especially small mats, which are covered by this name. The Anatolian rug is usually of heavy quality and not

very fine, but in coloring surpasses many others. The wool is exceedingly soft, and the colors frequently of primary dyes, and when mellowed by age, it develops a sheen which rivals silk productions.

Caucasian Rugs.—In Caucasian rugs, the geometrical ornamentation is carried to its perfection. All conceivable designs in line are employed with great profusion and bewildering effect. Generally there is one principal color to which all other colors are subjected in clear cut designs, sometimes without shadings, giving the effect of inlaid stonework.

In texture Caucasian rugs are medium, although there are some exceedingly fine specimens made, but these are exceptional.

In size these rugs are not very large, sometimes they are made long and narrow, but mostly of medium size.

In designing they show star shapes, circles, fretwork, insect shapes, diamonds, triangles, various forms of the Swastika, squares, medallions, dragon designs, etc.

These are the following principal well-known kinds of rugs made in Caucasia: (a) Daghestan; (b) Kabistan (Kuba); (c) Shirvan; (d) Darbent; (e) Karabagh; (f) Kazak; (g) Chichi; (h) Circassian; (i) Kashmir (Soumak).

The Daghestan, the Kabistan, and the Shirvan are rugs made on similar lines. Their colors, designs, and texture are not different from each other, except the Kabistan, which is usually of finer construction. The geometrical elongated star and the Swastika and other lineal decorations are common to all, with beautifully vivid colors attractively arranged.

The Darbent rug shows a strong, barbaric nature like that of the Kurd and Yuruk, only in the Darbent there is more uniformity of design, and the texture is not so coarse.

The Karabagh rug shows more of Persian mode of designing than any other Caucasian rug. Upon its black or brown field are strewn at regular distances, magnificent delineations of leaf and flower patterns in various shades of tan and old magenta colors—but this is the Karabagh of olden times. The modern product is a mixture of homely designs, crude dyes, and coarse weaving, showing a careless haste of workmanship.

The Kazak rugs are the heaviest of all Caucasians and different in floriation. It appears, the makers of these rugs have endeavored to develop the gruesome in design, for on their products are shown various grotesque shapes of the dragon and other creeping creatures with startling effect. One distinguishing point of Kazaks is in their size which is nearer square than any other Caucasian product; another, is in the peculiar quality of the twisted yarn, which, when untwisted after years of usage, is divided into hundreds of fine ends, effecting the surface of the rug like a smooth velvety lawn.

Chichi rugs are made fine usually, and differ from other Caucasians in ornamentation. On a dark or light colored field are distributed regular patterns in cut squares or rectangular forms, giving the appearance of latticed panel.

Circassian rugs depart entirely from Caucasian mode of ornamentation. These are among the choicest, if not the choicest products of this region. A favorite design consists in pattern of superb flowers in full bloom, or

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foliage artistically clustered and connected one with the other by graceful long lines.

Kashmir (Sumak or Shamakha) rugs are devoid of nap, they are made what is commonly known as the flat stitch style like the old Kashmir shawls of India from which they derive the name. In design they are typical Caucasians, and by reason of the absence of the nap, they show their designs in bold relief, clear cut, and prominent. The long ends of the yarn, left on the back, give weight and softness of texture.

Turkoman Rugs.—There are two divisions of the Turkoman rugs: Western and Eastern. In the Western Turkoman rugs the chief color, universally employed, is red with all its shades and kindred colorings, and the principal design, the octagonal or Bokhara; embracing the following well-known specimens: (1) Bokhara; (2) Afghan or Khiva; (3) Yomud; (4) Bushir; (5) Beluchistan.

Of these, Bokhara rugs are the finest and most valuable. It is impossible to mistake the Bokhara after once seen. The octagonal device, in shades of blues, ivory, and reds, is stamped on every Bokhara upon a field of some shade of red. The octagonal pattern is divided into four, with the diagonal sections resembling each other. They are the finest of all Turkomans in texture and sometimes so fine that they rival the best productions of Persia.

The praying-rug of this class preserves the general characteristic color of red. It, however, shows no octagonal device; there is the usual dome pattern in a more pointed shape near the top; and the whole rug, usually about four feet by five, is divided into four sections, decorated with highly conventionalized devices of the Swastika.

Afghan or Khiva rugs, made of coarser texture and of larger size, adhere to the Turkoman red and octagonal pattern most faithfully—in the large regularly arranged octagon is often seen clover leaf and sometimes a portion of dragon designs. Rich in coloring, heavy in pile, these rugs frequently mellow into lustrous and velvety fabrics.

The Yomud rugs are of darker shades of the maroon; and the detached regular octagon is transformed into an elongated diamond design fringed with dragon claws or Swastika devices. The Yomud usually is of very fine texture and is made in large size.

Bushir rugs classed, herein, are Turkoman only in coloring and texture. They show no octagonal pattern; often being decorated with palm devices; sometimes with Herati designs, and with ornamentations generally found in Caucasians. Made in rather longish sizes, loose texture, strong, silky, and desirable.

Beluchistan rugs are another class of the Turkomans which bear no resemblance to the Bokhara. Generally small in size, they deviate from the red shades often, and show subdued shades of maroon, blue, ivory, camels' hair, and rarely green. In design they employ the floral as well as geometrical forms. The general effect of Beluchistans is dark.

Eastern Turkoman rugs may be subdivided to: (1) Ganji or Genghis; (2) Samarkand; (3) Kashghar; (4) Yarhand.

The Ganji rugs are made by Turkoman nomads, of goats' hair or wool with long silky texture, the principal color being white or

yellow, on which are spread at regular distances rather crude geometrical devices.

Samarkand rugs reveal Chinese characteristics in coloring and design—usually of yellow, tan, or red and blue, they have several round figures intersected with strange floral designs and geometrical patterns.

The fret decoration is pronounced on their borders. Heavy and rather coarse in construction these rugs are attractive by reason of their simplicity of designing and uniqueness of coloring.

Kashghar rugs, coarse in texture are stolid in design and simple in coloring. Often only three different colors appear—a solid color for the field and another solid color for the simple geometrical design and a third, to separate the lines and to mark the borders. These and the Yarkhand rugs similar to these, rarely leave their native places, the easternmost part of Turkestan.

Indian Rugs.—Strictly speaking India sends out only large carpets, the manufacture of which is in the hands of European and American firms, who have established large centers of production in the Punjab, Kashmir and Madras districts, commonly known as Agra, Lahor, Amritsar, Mirzapur, Kandahar, Ardahan, etc. Arbitrary names these last, named by the manufacturers themselves without regard to location.

These American and European houses not only control the output of rugs but also their ornamentation and coloring; they make rugs to order, according to the ordered colors and patterns required by their customers. Thus individuality and character is altogether wanting in these productions, albeit they are made to endure, being heavy, closely made and of attractive colorings.

Mr. Ruskin sums up the detereorating effect of European control on the Indian rugs in the following manner—"Modern commercialism has laid its poisonous trade upon this useful industry since the days when I was a young man and to-day it is almost ruined as an art."

It may be added that to-day "this useful industry . . . as an art" is altogether ruined with no hope of its revival.

Chinese Rugs.—It is a matter for the historian to decide whether or not the Chinese are the original rug makers of the world; it is evident however that rugs were made in China a very long time ago and some of them of surpassing beauty; thus the white silk rug taken to Mecca as a covering for the holy shrine of Kaaba, antedated by hundreds of years the appearance of the great prophet of Arabia.

Chinese rugs form a distinct type, their designs consist of all kinds of odd geometrical devices, all imaginable curves and angles and many quaint configurations of the Swastika or the lotus flower which are distributed with unique formations on fields of yellow, blue, red, fawn, gold, and tan in all their exquisite shades marvelously blended.

Chinese mode of ornamentation may be called the Kaliedoscope of texture. Generally of long, soft wool or silk or camel's hair these rugs while not made as fine as some Persian rugs, still they reveal masterly skill in texture with iridescent sunset colors and magnificent sheen. They are among the most valuable of all Oriental rugs and among the rarest on the

RUGS — RUISDAEL

European or American market; and they command highest prices.

Kilims.—Kilims, while products of the Orient, are not rugs, for they possess no pile and their mode of construction is different.

Kilims resemble the Kashmir or Shemakha rugs and are made in the same manner, that is on the flat stitch plan, with this difference however that while the loose ends of the yarn are left on the back of Kashmir rugs, in Kilims they are wound around the woof, and in changing the yarn to change the color also a separate warp thread is taken up, thus leaving a small oblong open space between the two stitches. Kilims thus made present the open work effect in texture.

Kilims are of lighter weight, often both sides made alike and are not appropriate for floor coverings. They are the tapestries of the Orient, and in whatever district made, they follow the usual rug pattern of that district. The finest Kilims are made in Sehna, where the finest rugs are made, in Persia; and also in Bokhara. Small Kilims made in Turkey are often called Kiz-Kilim, woven by the hands of Turkish maidens for purposes of dowry or devotion, or for presents to their marriageable friends and relations, they are therefore, highly decorative and often with unusually beautiful designs. Kilims are made also in Caucassia and Kurdistan known as Shirvan and Kurd Kilims respectively.

In the Orient their use is manifold—as rugs, hangings both for doors and walls, and for tents, as mantles by day time and covering by night for travelers; made for bags and covering for bags, and also for covering of the person; they serve for other conveniences entirely unknown in civilized communities.

B. PESHMALYAN.

Rugs, Weaving of. The commerce in Oriental rugs, especially those from Persia, Russia and Turkey, is very considerable in the United States. A few come from India and China, and some are woven in Afghanistan and Beluchistan. While there is a large production of rugs of various kinds in America the imported rugs continue to hold high favor among American buyers. Many of the costly Eastern rugs are as simply woven as a Navajo blanket, or even a rag carpet. The process is in many cases, almost identical, the variation being only in closeness or fineness of warp and arrangement of color. The Navajo blanket is a product of Indian manufacture. The manufacture of rugs in the United States is an industry of considerable importance. A great variety of weaves is produced,—woolen, cotton, and grass rugs, made in some cases after European models and methods and in others after original designs and methods of construction, both as to the machinery used, the dyeing of the fabrics, and the designs. Grass rugs for the country house have won recent prominence in our domestic commerce. Some of these are made of tough fibres and others of less durable material. Some have their colors woven into the mesh and some have stencilled designs in fast colors.

Another phase of the weaving of rugs in the United States is their manufacture in the home. Rag carpets have been made and used in farm houses for many generations, but of late there has been a general demand, especially in country houses, for home-made piazza rugs,

bedroom rugs and rugs for general use. An authority on the home weaving of rugs is Mrs. Candace Wheeler, whose recent work on 'How to Make Rugs' is a practical hand book. The Onteora rug, the Lois rug, the Isle La Motte rug, the Lucy rug and other home-made designs are described. The pattern, the dyeing, and braiding the fringe of the border all are featured and described. This writer states that "the cumbrous old woolen loom is still doing a certain amount of work in every country neighborhood, and it is capable of a greatly enlarged and much more profitable practice. I find very little, if any difference in the rugs woven upon these and the modern steel loom. It is true that the work is lighter and weaving goes faster upon the latter, and where a person or family makes an occupation of weaving, it is probably better to have the latest improvements, but it is possible to begin and to make a success of rag-rug weaving upon an old fashioned loom." In the matter of pattern and coloring it is stated that the Onteora rug is made by using a proportion of a half pound of blue rags to the two and a half white required to make up the three pounds of cotton filling required in a six foot rug. The side border in the Lois rug is made upon the same blue warp, is separately woven and afterward added to the plain white rug with blue ends. And she describes further details of her method. Many of the rugs described by Mrs. Wheeler are washable. Her work is also the building up of neighborhood industries in domestic rug making, a work which has taught both economy and art.

The larger subject of the domestic manufacture and commerce in rugs made in the United States may be broadly considered under the general subject of Carpets, (q.v.). The principal varieties of carpets now in use are the Turkey, the Axminster, the Brussels, the Wilton, the Venetian, the Dutch, the Kidderminster or Scotch, the Whytock's tapestry and velvet pile, and the printed felt carpet. Generally speaking, rugs, though made in England or the United States, follow somewhat these same designations and are similar in appearance though made on the most modern looms. A very beautiful fabric has also been introduced, called the Patent Wool Mosaic.

Ruhmkorff, room'kōrf, **Heinrich Daniel**, German inventor: b. Hanover 1803; d. Paris 21 Dec. 1877. He removed to Paris in 1839, where he continued to reside. In 1851 he invented the induction coil which bears his name.

Ruisdael, rois'dāl, or **Ruysdael**, **Jacob van**, Dutch painter: b. Haarlem 1626; d. there 1682. He was the son of a painter, and probably studied art under his father and an uncle, who was also a painter. In 1648 he entered the guild of his native city, and some nine years later settled in Amsterdam, where he received citizen rights in 1659. He appears to have traveled throughout his native country and in parts of Germany and Switzerland. Ruisdael was not much appreciated during his lifetime, but is now ranked among the greatest of the Dutch painters of landscape. His pictures, comprising well-chosen forest, waterfall, shore, mountain, and similar scenes, are often of a melancholy, but always of a deeply poetical character. The figures in them were painted by Berchem, Van de Velde, Van Ostade, Wouwerman, Lingelbach, and others. All the chief European

RULE BRITANNIA—RULES OF THE ROAD

galleries contain examples of his work, the number in the National Gallery being 12. Consult: Michel, 'Jacob Van Ruysdael et les Paysagistes de l'Ecole de Harlem' (1890).

Rule Britannia, the national song of Great Britain, the joint production of James Thomson and David Mallet, first performed before Frederick, prince of Wales, at Cliefden House, 1740. See NATIONAL SONGS.

Rules of Faith, the phrase-worn *regula fidei* of polemical theology is the term applied to what is considered the code from which the Christian faith is to be derived, and has been in use since the 2d century. The items of the creed differ in the various sects. The Reformers held that the Scriptures alone could be safely accepted as a rule of faith. Roman Catholics hold that the testimony of the Church is the true rule of faith, regarding the Church as the vital and infallible organ of the teachings of Jesus Christ under the guidance of the Holy Ghost, while they look upon the Bible as the divinely inspired word of God to be interpreted by the Church. Protestants acknowledge the authority of Christ, his apostles, and all inspired writers, but deny that any doctrine not contained in the Scriptures has any binding authority. Certain members of the English Church admit what they call the consent of the fathers as authoritative interpretation of the Scriptures.

Rule Nisi, nī'sī, or Rule to Show Cause, in English and United States law, an order granted by the court on an interlocutory application (formerly always *ex parte*), directing the party opposed to the applicant to do or abstain from some act unless (*nisi*) he can show cause why the order should not be obeyed. If cause is shown, the order is "discharged," otherwise it is made "absolute."

Rule of Three. See PROPORTION; ARITHMETIC; ARITHMETIC, HISTORY OF.

Rules of the Road, the official designation of regulations adopted by national or international authorities for the management of vessels in storms, fogs, or other danger. Under act of the United States Congress, in 1896, the rules already established were considerably changed to comport with the schedule to be observed by vessels of all civilized nations on and after 1897. These rules apply also to inland waters, excepting the Great Lakes, for which a special set has been devised. The following is a synopsis of the new rules: "Vessels are in the first place cautioned against showing any other lights than their distinguishing ones in such a way as to permit any possibility of confusion. An additional white light is, however, given to a steam vessel under way to be carried at least 15 feet lower than the one now provided for, and forward of its vertical line. A vessel which is towing another vessel or barge is also allowed a small white light to be carried aft, and in such a position that it shall not be visible forward of the beam, which may be used for the towing vessel to steer by. The following regulations are also provided for small vessels:

"1. Steam vessels of less than 40 tons shall carry (a) in the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the gunwale of not less than nine feet, a bright white light

constructed and fixed as prescribed in article two (a), and of such a character as to be visible at a distance of at least two miles. (b) Green and red side lights constructed and fixed as prescribed in article two (b) and (c), and of such a character as to be visible at a distance of at least one mile, or a combined lantern showing a green light and a red light from right ahead to two points abaft the beam on their respective sides. Such lanterns shall be carried not less than three feet below the white light.

"2. Small steamboats, such as are carried by seagoing vessels, may carry the white light at a less height than nine feet above the gunwale, but it shall be carried above the combined lantern mentioned in subdivision one (b).

"3. Vessels under oars or sails of less than 20 tons shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

"4. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision. Additional regulations are provided for pilot vessels on duty at their stations as follows: On the near approach of or to other vessels they shall have their side lights lighted, ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side. A pilot vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the mast-head, and may instead of the colored lights above mentioned, have at hand, ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above. A vessel in or near a fair-way, when aground, is required to carry in addition to it, the two red lights which signify a vessel not under control but not desiring assistance. A steam vessel under sail only, but having her funnel up, shall carry forward where it can best be seen, one black ball or shape, not two feet in diameter.

"The manner of fog signaling is also more definitely fixed as follows: Article 15. All signals prescribed by this article for vessels under way shall be given: (1) by "steam vessels" on the whistle or siren. (2) By "sailing vessels" and "vessels towed" on the fog horn. The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration. (a) A steam vessel having way on her shall sound, at intervals of not more than two minutes, a prolonged blast. (b) A steam vessel under way, but stopped, and having no way on her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between. (c) A sailing vessel under way shall sound at intervals of not more than one minute, when on the starboard tack, one blast; when on the port tack, two blasts in succession, and when with the wind abaft the beam, three blasts

RULING MACHINES—RUMANIA

in succession. (d) A vessel when at anchor shall, at intervals of not more than one minute, ring the bell rapidly for above five seconds. (e) A vessel when towing a vessel employed in laying or in picking up a telegraph cable, and a vessel under way, which is unable to get out of the way of an approaching vessel through being not under command, or unable to maneuver as required by the rules, shall instead of the signals prescribed in subdivisions (a) and (c) of this article, at intervals of not more than two minutes, sound three blasts in succession, namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other. Sailing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals, but, if they do not, they shall make some other efficient sound signal at intervals of not more than one minute." See **COLLISION**.

Ruling Machines, in blank-book manufacture and bookbinding, are instruments used for ruling paper, metal, etc. The first machine of this kind was invented by a Dutchman, resident in London, in 1782, and was subsequently greatly improved by Woodmason, Payne, Brown, and others. F. A. Nobert devised a ruling machine in 1845 for the production of microscopical test plates, diffraction gratings, and micrometers, etc., and more recently Benjamin Day, a New York artist, patented one for use by artists.

Rum, a distilled liquor obtained from the fermented juice of the sugarcane or molasses. Rum owes its flavor to a volatile oil and butyric acid, a fact which has been taken advantage of to prepare a butyric compound called essence of rum to enable the spirit-dealer to manufacture a fictitious rum from malt or molasses spirit. The color is usually imparted after distillation by adding burnt sugar or caramel.

Rum, Romanism, and Rebellion, in American political history; at a meeting of clergy, in which all denominations were supposed to be represented, held in the Fifth Avenue Hotel, New York, during the Presidential campaign of 1884, in the interest of the Republicans, Rev. R. B. Burchard described the Democrats as the party of "Rum, Romanism and Rebellion." This remark was unfortunate for the Republicans, and aided in a great measure to win the election for the Democrats.

Rumania, roo-mă'nî-a, or **Roumania**, a kingdom of southeastern Europe, bounded by Austria-Hungary, Russia, the Black Sea, Bulgaria, and Servia. Area, 50,720 square miles. It comprises the provinces of Moldavia and Wallachia, prior to 23 Dec. 1861, Danubian principalities; to these have been added the province Dobrudja on the Black Sea. The principal towns are Bucharest, the capital; Jassy, Galatz, Braila, Botosai, Ploësti, Craiova, Berlad, Focani.

Topography.—The surface consists mainly of undulating and well watered plains of great fertility: from the Carpathian Mountains on the north and west borders, where the summits range from 2,600 feet to 8,800 feet, they gradually slope downward to the river Danube which for 595 miles flows through Rumanian territory, and forms the major portion of the southern

boundary with Bulgaria. The entire kingdom is in the basin of the Danube, the chief Rumanian tributaries of which are the Alt-or Aluta, the Arjish, Jalomnita, Buzeo, Sereth, Berlad and Pruth, the last forming the eastern boundary with Russia. The Danube forms a number of marshy lakes as it approaches the alluvial region of the Dobrudja, mostly a land of steppes and marshes, unhealthful and uncultivated, through which the Danube discharges itself into the Black Sea by the Saint George, Sulina, and Kilia channels.

Geology, Natural Resources, etc.—In the region of the Carpathians, the geology is of the Tertiary period practically completed at the end of the Miocene period, and almost entirely composed of primitive rocks. The kingdom possesses considerable mineral wealth; rock-salt abounds in the vicinity of the Carpathian Mountains, and the salt mines of Wallachia are apparently inexhaustible. Petroleum and asphalt are abundant; a great quantity of saltpeter is produced, chiefly in the northern part of the country; sulphur is found in more limited quantities. The only metal of importance is copper, which has been worked to some extent; gold is washed from the sands of several streams. About one sixth of the surface is covered with forests of oak, fir, beech, and other valuable timber trees.

The fauna includes stags, wild boars, bears, wolves, foxes, wild goats, hares, and martens; while fish abound in the rivers. The climate is subject to greater extremes than at the same latitude in other parts of Europe; the summer is hot and rainless; the winter, sudden and severe, the Danube and its tributaries being regularly frozen for about six weeks; there is almost no spring, but the autumn is long and pleasant. Rumania is an essentially agricultural and pastoral state, fully 70 per cent of the inhabitants being directly engaged in husbandry. The chief cereal crops are maize, wheat, barley, rye, and oats; tobacco, hemp, and flax are also grown; and wine is produced on the hills at the foot of the Carpathians. Cattle, sheep, and horses are reared in large numbers.

Manufactures, Commerce, etc.—Since the passing of the law in 1887 for promoting national industries, some progress has been made in manufactures, chiefly along the line of domestic commodities. Trade is fairly active, but is almost entirely in the hands of foreigners; the internal trade is chiefly carried on by Jews, who are subject to certain disabilities. The chief exports are grain (especially maize), cattle, timber, and fruit; the chief imports, manufactured goods, coal, etc. Germany, Great Britain, and Austria-Hungary appropriate by far the greatest share of the foreign trade, the bulk of which passes through the Black Sea ports. In 1901 the exports were valued at \$70,766,175, the imports at \$58,487,172; in 1900 and 1901, the value of the exports for the first time exceeded that of the imports. In 1902 there were 2,295 miles of state railway, 4,344 miles of telegraph lines, and a rapidly extending telephone system. The government monopolizes also salt and tobacco. The French decimal coinage has been introduced, the franc being called *leu* (pl. *lei*), the centime *bani*. The metric system of weights and measures has also been officially recognized, but a diversity of local standards is still common.

RUMANIA

Government.—Since 1881 the ruler of Rumania has had the title of king, in accordance with the decision of the Rumanian Parliament. Previously the title was prince, or in Rumanian *Domnu* (L. *dominus*, lord). The present ruler was elected by the people, but the dignity is hereditary. There are two legislative houses, a senate of 120 members elected for eight years, and a chamber of deputies of 183 members elected for four years. The members of both chambers are chosen by indirect election, the first voters choosing electors, and these in their turn the deputies. A deputy must either belong to a learned profession, to a military or civil service, or have an annual income of about \$2,000, and must be 25 years of age. All citizens of full age and paying taxes are electors. The sovereign has a suspensive veto over all laws passed by the two chambers. The executive is in the hands of the sovereign assisted by a council of seven members, the heads of the departments of the interior, of finance, of war, of foreign affairs, of justice, of agriculture, commerce, and public works, and of public instruction and worship. For purposes of local government Wallachia is divided in 17, Moldavia into 13, and Dobrudja into two departments, each administered by a prefect, a receiver of taxes, and a civil tribunal. Judges are removable at the pleasure of the superior authorities. The legal codes are founded on the civil law and customs of the two provinces; but though several reforms have been effected in the system of jurisprudence much yet remains to be done, especially in the administration of the law, which is said to be very unsatisfactory and corrupt. The budget estimates for 1909-10 were £17,427,413 revenue, expenditure, £18,039,907. The public debt in 1909 amounted to £59,310,089.

Army and Navy.—The military forces of Rumania are divided into five classes: (1) the permanent army, with its reserve; (2) the territorial army, with its reserve; (3) the militia; (4) the civic guard; and (5) levies *en masse*. Every male inhabitant, from the age of 21 to 46, must serve three years in the permanent army in active service and five years in its reserve, or five years in the territorial infantry and three years in its reserve. The active service in the cavalry of the territorial army lasts four years, and is followed by four years in its reserve. Whether a young man enters the permanent or the territorial army is determined by lot. Those who for some sufficient reason have not been subjected to the conscription form part of the militia, and those who have finished their term in the permanent or the territorial army also enter the militia till the age of 36. After this age, in the country they enter the levies *en masse*, in the towns the civic guard. The total strength in times of peace of the permanent army is 60,000 men and 3,280 officers, with 390 pieces of ordnance. The territorial army has a total strength of 72,000 men. The militia has a total strength of 33,000 men. The effective force of the civic guard and the levy *en masse* is not definitely fixed; but altogether Rumania can put into the field about 200,000 men. The navy is insignificant, there being only one armored cruiser of any consequence.

Ethnology and Population.—The Rumanians claim to be the descendants of a colony of Romans located here by the Emperor Trajan, and

call themselves *Romeni*; hence the name of Rumania, which is now universally adopted by the natives as the name of the united principalities. The race is, however, a mixed one, being modified by Greek, Gothic, Slavic, and Turkish elements. This mixture makes itself apparent in their language, three fourths of the words of which, however, are almost pure Latin; among words in common use are, *apa* (L. *aqua*), water; *pane* (L. *panis*), bread; *alby* (L. *albus*), white; *negru* (L. *niger*), black; and so on. The conjugations also of the verbs, which are four in number, correspond exactly to the four conjugations in Latin. For a long time Greek was the language spoken by the court and the upper classes; but latterly this language has been largely superseded by the French. The population of Rumania, according to the latest census, was 6,300,000, among whom the Rumanians proper numbered 5,500,000. The Rumanians are in general strong and stoutly built, with black hair, brilliant eyes, and a complexion similar to that of the Italians. Besides the Rumanians proper there are about 300,000 Jews, 200,000 Gypsies, 85,000 Slavs, besides Germans, Magyars, Greeks, etc. There are also large numbers of Rumanians inhabiting Hungary, Transylvania, Bessarabia, and elsewhere.

Sociology.—Since the introduction of railways great changes have taken place in the condition of the people. The peasants were never, properly speaking, serfs, but being compelled to work gratis for the proprietor a certain number of days every year they became fixed to that part of the country in which they were born. They are now not only perfectly free, but each head of a family received during the late Prince Couza's reign a small portion of land, of which he became absolute proprietor, the landlord having been compensated by receiving bonds bearing 10 per cent interest. Their dwellings are generally of a wretched description. Many of the towns are merely agglomerations of large houses, the residences of the boyards, surrounded by the huts of their dependants. The streets are ill paved, or, as is most generally the case, not paved at all, and are usually filthy; the roads, of which there are too few, are in most cases in a wretched state. Agricultural labor, the chief employment of the inhabitants, is cheap, as most of the laborers are so poor that they engage for work to be done three years afterward, in order to obtain advances of money. More than three fourths of the population are peasants. Handicraftsmen are comparatively few in number, as the peasant usually builds his own house, and makes his own furniture and other utensils. In Moldavia there are about 3,000 boyards, besides an extensive lower nobility; in Wallachia they are still more numerous, every twenty-eighth man being a nobleman. There is no native middle class, and the higher ranks of society have only the law open to them as a profession. The commerce of the country is in the hands of the Jews and foreigners. The staple food of the inhabitants is maize; the common beverage is wine, which is produced in great quantities though mostly of inferior quality. This, however, is owing altogether to the manner in which it is made, and, as already stated, some good wine is also produced. The common people are good-humored, sober, and cleanly; murder and robbery are almost unknown.

RUMANIAN LANGUAGE AND LITERATURE

Religion and Education.—The established religion is that of the Greek Church, to which about 97 per cent of the population belongs. At the head of the clergy are the metropolitan archbishops of Moldavia and Wallachia, the latter of whom is primate of Rumania. Each bishop is assisted by a council of clergy, and has a seminary for priests. In 1863 the national finances were so low that the government was compelled to appropriate the estates of the monasteries, whose revenues amounted to about a third of that of the state, allowing in return a sum of about £700,000 for the support of the religious communities. It was determined that the balance should be devoted to the support of schools, hospitals, the relief of the poor, etc. Rumania possesses 4,000 elementary schools, 54 high schools, eight normal schools, and two universities, besides other special schools. Education is compulsory, but is still very backward.

History.—Rumania formed an important part of the Dacian territory which was conquered by Trajan and formed into a Roman province in 106 A.D. It became the battle-field of the Goths, Huns, Bulgarians, Magyars, and Poles, who in succession held for a more or less lengthened period possession of the country. All these races left some traces of themselves among the Romanized Dacian inhabitants, thus contributing to form that mixed people who in the 11th century were converted to the Christianity of the Greek Church. About that epoch the Kumans, a Turkish tribe, established in Moldavia an independent kingdom. Two centuries later it fell into the hands of the Nogai Tartars, who so desolated the country that only in the mountains and forests was left any trace of the native population. Toward the end of the 13th century Radu Negru of Fogarash, a petty Transylvanian chief, took possession of part of Wallachia, divided it among his boyards, founded a senate of 12 members and an elective monarchy, and in the course of time conquered the whole province. About the middle of the following century Bogdan, a Hungarian chief, made a successful attempt to re-people Moldavia. Struggles for the ruling power, civil and foreign wars, and invasion by the Tartars induced the Rumanians in the beginning of the 16th century to place themselves under the protection of the Sublime Porte, and the boyards were gradually deprived of their power to elect their own ruler, whose office was bought and sold at Constantinople. Woiwodes of various nationalities were now successively appointed, but their rule proved inefficient in establishing peace and subjection to the sultan, as the boyards never lost an opportunity of making known their dissatisfaction. One of the most distinguished foreigners was Basil Lupulo, a Greek of Epirus, who promoted civilization and learning, but was deposed in the middle of the 17th century. From 1732 to 1822 the country was governed, or rather misgoverned, by Fanariot princes, who merely farmed out the revenues, enriching themselves and impoverishing the land. A considerable number of the boyards, through intermarriage with the Fanariots, were more than half Greek by descent; the court language was Greek, and the religious and political sympathies of the country lay in the same direction. In 1802 Russia succeeded in establishing a sort of protectorate over the principalities, and in 1821 a desper-

ate struggle to throw off entirely the Turkish authority almost desolated the land. In 1822 the sultan was compelled by Russia to select the princes of the provinces from natives, and seven years later to allow them to retain their office for life. In 1853 Russia took military possession of the provinces, but was compelled in a short time to retire, Turkey having received the assistance of France and England. In the treaty of Paris at the close of the Crimean war in 1856 it was agreed, among other things, that the principalities of Moldavia and Wallachia should continue to enjoy, under the suzerainty of the Porte and under the guarantee of the contracting powers, the privileges and immunities of which they were in possession; and that no exclusive protection should be exercised over them by any of the guaranteeing powers. The Porte engaged to preserve to the principalities an independent and national administration. In 1858 the principalities were united under one ruler, Colonel Couza, who took the title of Prince Alexander John I. In 1861 Moldavia and Wallachia were formally brought under one administration. A revolution which broke out at Bucharest in February 1866, forced Prince Alexander to abdicate, after which the representatives of the people elected as ruler Charles, son of the late Prince Charles of Hohenzollern-Sigmaringen. In the Russo-Turkish war of 1877–8 the principality sided with Russia, but in spite of the important services which it rendered in that war, it was compelled at the close of the war to retrocede the portion of Bessarabia which it acquired at the conclusion of the Crimean war, and to receive in exchange the Dobrujda. Early in the war the principality proclaimed its independence of Turkey, and its independence was recognized in the Treaty of Berlin, July 1878. As already stated it became a kingdom in 1881, Prince Charles becoming king as Charles I. His wife is well known as a writer under the pseudonym Carmen Sylva. His nephew and heir, Prince Ferdinand, was married in 1893 to Princess Marie, daughter of the late duke of Saxe-Coburg-Gotha.

Consult Laveleye, 'The Balkan Peninsula' (1887); Samuelson, 'Rumania, Past and Present' (1882); Walker, 'Untrodden Paths in Rumania' (1888).

Rumanian Language and Literature. The racial language, Rumanian or Wallachian, is of the Romance type (see ROMANCE LANGUAGES) derived from the Latin, but with many Slavonic, and some Greek, Turkish, and Albanian words. The number of Latin roots is variously estimated at more or less than half of the total, the next greatest element being Slavonic, according to some authorities almost equaling the Latin. The majority of the population speak what is practically the same language—the Daco-Rumanian—throughout the kingdom, in Transylvania, in the Banat, and other parts of Hungary, Bukowina, and Bessarabia. The Macedo-Rumanian, spoken south of the Danube and among the Balkans and Pindus, is largely modified by Greek; and the Istro-Rumanian, spoken in Istria and Croatia, has been much Slavonized.

The first Rumanian book, a psalter, was printed in 1577, but Rumanian literature practically dates from the chronicles of the 17th century, which are the earliest specimens of its national literature. Greek was long the language

RUMELIA—RUMINANTS

of the educated and aristocratic classes, but has been supplanted by French. In matters of general culture, little progress was made until the 19th century, when a popular Rumanian literature arose, the most interesting portion being the songs. Of these Basile Alecsandri (1821-90), one of the most notable of native poets and a patriotic and influential journalist, made a valuable collection (1866). Other distinguished names are Konstantin Negruzzi (1806-68), author of verses, plays, and historical studies, in prose and verse; Jakob Negruzzi (1843-), son of the former, author of poems, sketches, and tales widely read; Grigoic Alecsandrescu (1812-86), poet and political leader; Dimitrie Bolintineanu (1826-72), poet and novelist; and Michael Eminescu (1849-89), the great lyric poet of Rumania. German translations have been made by Kotzebue, Schott, Kremnitz, Rudow, and others, including 'Carmen Sylva' (q.v.), Queen of Rumania, herself an accomplished poet, novelist, and dramatist. Dora D'Istria (q.v.) pen-name of Elena Ghica (1828-88), wife of a Russian prince, is the author of Rumanian travel-sketches, and of historical and literary studies of great value, mostly written in French. Among authorities on the language are Hasden, Gaster, Titkin, and Franz von Miklosich, the latter the founder of Slavic philology, and author of 'Comparative Grammar of the Slavic languages,' and 'Etymological Dictionary of the Slavic languages.' There are histories of Rumanian literature by Cipariu, Densusianu, Gaster, Popfii, and Philippide. The great dictionaries are those of Codrescu (1875), Lawrianu and Massimu, 'Dictionariulu Limbei Romane' (1876-9); Hasden, 'Etymologicum Magnum Romanie' (1885-92); and there are standard chrestomathies by Pompiliu, and Gaster (1891). Consult Warner, 'Library of the World's Best Literature' (1899).

Rumelia, roo-mé'li-a, **Eastern**, Turkey in Europe, a province established, with administrative autonomy, by the treaty of Berlin, 1878, but now united with Bulgaria, and known also as southern Bulgaria. It is bounded on the north by the Balkan Mountains, on the east by the Black Sea, on the south by a line beginning at Cape Seityn about lat. 42° 20' N., and proceeding west-southwest to the Rhodope Mountains, and on the west by the watershed between the Maritza and the Karasu. Originally it was arranged that the province was to be under the direct political and military authority of the sultan, but it was to be administered by a Christian governor-general appointed for five years by the Porte, subject to the approval of the European powers. This arrangement took effect and continued for a few years, but in 1885 the government was overturned by a popular movement and a union with Bulgaria carried out, in which the Porte has acquiesced. The capital is Philippopolis. The area is 13,700 square miles. Pop. about 1,200,000. See BULGARIA.

Rum'ford, Count. See THOMPSON, BENJAMIN.

Ru'minants, herbivorous split-hoofed animals, characterized especially by chewing the cud; they include the camels and llamas, giraffes, deer, pronghorns, antelopes, sheep, goats, and ox-tribe, and hence nearly all of the mammals most economically important to man. All of

these, except the camels and giraffes, are represented on the continent of North America, and two—the pronghorns and musk ox—are peculiar to it. In most no incisor or canine teeth exist in the upper jaw, the place of these teeth being supplied by a hardened or callous pad of gum, against which the lower incisors bite. Six incisors exist in the lower jaw. Canines are always present in the lower jaw, and are usually inclined forward and toward the incisors, which they nearly resemble in form. The general number of lower canine teeth is two. The molar and premolar teeth number six on each side of each jaw, and are selenodont, that is, possess flattened crowns topped by two double folds of enamel of an irregular crescentic shape. The stomach is divided into four compartments. (See DIGESTION.) In the process of feeding the herbage is rapidly cropped off by the lower incisors pressing against the hardened gum of the upper jaw. The food mixed with saliva is swallowed into the paunch, where it is simply moistened and then passes into the reticulum or second compartment. The aperture of the gullet now closes, and the mass of food contained within the gullet is propelled upward into the mouth by a muscular action similar to vomiting. Mastication of the food is now effected by a kind of rotatory motion, the lower jaw thus giving a first stroke, for example, from left to right, and the rotary motion continuing persistently afterward from right to left, or in the opposite direction to the first movement of the jaws. This is "chewing the cud." In the camels the motion of the jaws is said to be simply one from side to side. After being thus thoroughly masticated and remixed with saliva, the food is again swallowed, and passes at once on into the third stomach, and is assimilated.

Two distinct divisions of the ruminants may be recognized, according to nature of the horns, known respectively as the "solid-horned" and the "hollow-horned."

The first section includes the giraffe (although no external antlers arise), the deer and pronghorns; and the other the antelopes and the sheep, goat, and ox tribes. The antlers of deer consist of nearly homogeneous bony tissue, lighter and more porous in structure than ordinary bone; are generally much branched or forked, and are shed and renewed every year. (See ANTLERS; DEER.)

The horns of the hollow-horned ruminants are entirely different from the antlers of deer, in structure as well as in manner of growth. They are usually common to both sexes, as in our domestic cattle, are simple and not branched, and grow continuously throughout the life of the animal, though very slowly after it has reached maturity, and are never shed. They consist of a bony core—an elongated process from the frontal bone—covered with a sheath of horn. (See HORN.)

Technically speaking, the ruminant game animals of North America consist of three distinct families, two of which are represented by several genera, and some of the genera by numerous species. These families are: the pronghorns (*Antilocapridæ*); the deer (*Cervidæ*); and the sheep, goat, and ox tribes (*Bovidæ*). They are all "game animals," and some of them are rapidly approaching extermination. The pronghorns, though usually called the American

antelope, is not a true antelope, but is of a distinct family type, found only in North America, and peculiar in the fact that its horns are branched and are shed annually. (See PRONGHORN.) The deer tribe consists in America of five genera, namely, the wapiti (*Cervus*); the small deer of the United States and Mexico (*Dama*, or *Odocoileus*); a Central American brocket (*Mazama*); the moose (*Alces*), and the caribou (*Rangifer*). These are separately described under their names. Altogether between 25 and 30 species of deer exist in North America, including Mexico. Of the ox and sheep tribes or horned ruminants, the most prominent native member is the almost extinct bison (q.v.). The mountain sheep (see BIGHORN) number five species, and the Rocky Mountain goats (q.v.) number two species; but of most of these species so few examples are known, and their range is so limited that it may well be doubted whether they will ultimately be regarded as distinct. The goats and sheep are mountain dwellers, their favorite haunts are the more inaccessible parts of the higher ranges, and they are exceedingly watchful and sagacious. They have been exterminated in the more accessible parts of their ranges, and survive in comparatively small numbers and greatly restricted areas. The musk-oxen, or musk-sheep, are a very distinct type, entitled to a distinctive name free from the implication of any such alliance; but the term musk-ox (q.v.) is not likely soon to be displaced. There are two species, the barren-ground and the Greenland.

The ancestors of the higher ruminants are mainly of Old World origin, and are comparatively scarce and late in appearance in the fossil beds of our own continent. The oldest forms definitely known were those of the family *Anthracotheriidae*, pig-like animals, with teeth approaching the selenodont shape, and a complete dentition; all the bones of the five-toed feet were free. The type-genus *Anthracotherium* (q.v.) begins in the Oligocene and continues down to the Pliocene, and is known from all parts of the world. Another early group was more sheep-like in its characteristics, and forms the family *Canotheriidae*, represented by *Canotherium*, which flourished in the Eocene and Miocene eras. They were small-sized, more delicate than modern sheep, the dentition was complete, and four toes reached the ground. Another large group was the family *Oreodontidae*, which was limited to North America, and whose remains have been found plentifully and usually in excellent condition in the Tertiary rocks of the eastern Rocky Mountain region. The oreodonts were ancestors of deer and antelopes, and some were horned, while all had five functional toes in front and four behind. Prominent genera are *Oredon*, of the size of a small pig; *Mesoreodon*, larger and stouter; *Casoryx*, *Agriocharus*, and most primitive of all *Protoreodon*. Another primitive family wholly European was *Anoplotheriidae*, represented by the long-known *Anoplotherium* (q.v.).

Rump Parliament, in English history, a name by which the remains of the Long Parliament was known after the expulsion of the majority of its members by the army of Cromwell, 6 Dec. 1648. It having been decided by a majority of the House of Commons that the con-

cessions made by Charles I. in the Treaty of Newport were a ground of settlement, Oliver Cromwell, who wished for the condemnation of the king, despatched two regiments under the command of Colonel Pride to coerce the House. In discharge of the resolution of the army that "none might be permitted to pass into the House but such as continued faithful to the public interests" Colonel Pride, whose regiment was stationed so as to block up all the entrances to the House of Commons, furnished himself with a list of the names of the members against whom the sentence of exclusion was passed, and as each approached prohibited him from entering. Forty-one members were placed under temporary restraint, and 160 ordered to their homes. Only 60 were admitted, all violent Independents, and these constituted the rump after the clearance wrought by Pride's purge, as it is called. This assembly, in conjunction with the army, brought about the arraignment, trial, and condemnation of Charles I. It was forcibly dissolved by Cromwell, 20 April 1653, for presuming to make a stand against certain demands of the army. Twice after this it was reinstated, but both times only for a brief period, and finally, on 16 March 1660, it solemnly decreed its own dissolution.

Rumsey, rüm'si, James, American inventor: b. Bohemia Manor, Cecil County, Maryland, in 1743; d. London, England, 23 Dec. 1792. He was a mechanical engineer, and while engaged as the superintendent of a mill in Shepherdstown, Va., conceived plans for the application of steam to marine propulsion. In 1786 he exhibited a boat upon the Potomac which was propelled by means of a steam pump which forced a stream of water from the stern. The Rumsey Society, in which Benjamin Franklin was greatly interested, was established in Philadelphia in 1788, and later an organization of the same name in England, to further his invention, but he died while his experiments were incomplete. He wrote 'A Short Treatise on the Application of Steam' (1788).

Rumsey, William, American jurist: b. Bath, Steuben County, N. Y., 18 Oct. 1841; d. New York 16 Jan. 1903. He was educated at Williams College, volunteered in the Union army in April 1861, and was granted his diploma from the college in June. He served through the war, attaining rank of captain of volunteers in 1863, major in 1864, and brevet lieutenant-colonel in 1865, in which year he was mustered out of service. He was secretary of the United States legation in Japan in 1865-6, and in 1880-1901 served as judge in the seventh judicial district of the supreme court. He then resigned and engaged in law practice until his death.

Runciman, rün'si-man, Alexander, Scottish painter: b. Edinburgh 1736; d. there 21 Oct. 1785. He was placed at 14 with some house-painters, who used to adorn the mantel-pieces of the houses which they painted with landscapes, of which many a specimen is still preserved in the houses of the Old Town of Edinburgh. He devoted himself entirely to this art; and acquired considerable local fame for his landscapes. In 1766 he visited Italy, where he met Fuseli, whose enthusiastic character matched aptly with his own. He spent five years in Rome, assiduously studying and copying the Italian masters; and in

RUNEBERG — RUNNYMEDE

1771 returned with powers increased and taste improved. Just at that time he obtained the mastership of the Trustees' Academy; and thus secured in the means of subsistence he applied his leisure to historical painting. Among his best-known productions may be mentioned: 'Macbeth and Banquo,' in a landscape; a 'Friar,' in a landscape; 'Job in Distress'; 'Samson Strangling the Lion'; 'Figure of Hope'; 'Saint Margaret Landing in Scotland'; 'Christ and the Woman of Samaria'; 'Agrippina Landing with the Ashes of Germanicus'; and the paintings in Ossian's Hall at Penicuik. The work last mentioned was the *chef-d'œuvre* of Runciman. He was remarkable for candor and simplicity of manners, and possessed a talent for conversation. Among his associates were Robertson, Hume, Lord Kames, and Lord Monboddo.

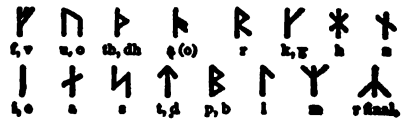
Runeberg, Johann Ludvig, yō'hän lood'vīg roo'nē-bērg, Swedish poet: b. Jacobstad, Finland, 5 Feb. 1804; d. Borgå 6 May 1877. He was educated at Wasa and at the University of Åbo. His first volume (1830) contained a number of lyrics and a long poem, 'Nights of Jealousy.' In 1832 appeared an epic written in hexameters 'Elgskytarne' (The Elk Hunters); in 1833 a second volume of lyrics, and in 1836 the idyl 'Itanna.' In 1837 he taught Latin literature at the university, became lector at the gymnasium of Borgå, where he remained until his death, being advanced to professor in 1844 and rector in 1847. His other works were the idyl 'Julqvällen' (Christmas Eve) and the epic 'Na donchda' (1841); Lyrics (1843); a romantic cycle, 'Kung Fjalar' (King Fjalar, 1844); narrative poems, 'Fanriek Ståls Sägner' (Ensign Stål's Stories, 1848-60); a rhymed comedy 'Kan ej' (Can't, 1862); 'Kungarne på Salamis' (The King at Salamis, 1863). His collected works were published in 1876 and posthumous works in 1878-9.

Runes, the characters used in writing by the Teutonic tribes of northwestern Europe in early times. Three classes of runes are recognized, Anglo-Saxon, German, and Scandinavian, but the differences of form which distinguish them are no wider than the differences between the alphabets employed in very ancient times by various Greek peoples—between the Old Athenian alphabet, for example, and the Old Corinthian, or between the earliest Phœnician and the earliest Hebrew. The name Rune is significant of the use to which this manner of writing was first applied. In Anglo-Saxon *rūn* means secret, and *runa* magician; and the knowledge of runes was confined to a small class—priests or sorcerers. For this reason, upon the introduction of the Christian religion the use of the runes was condemned as connected with heathenish superstitions. A poet of the 6th century, Venantius Fortunatus, tells of runes being written on tablets or slabs of ash (*fraxineis tabellis*), but there are extant numerous runes inscribed on memorial stones, rings, coins, etc., which have been found in Denmark, Norway, Sweden, Germany, and Iceland, and in Britain within the limits of the ancient kingdoms of Northumbria, Mercia, and East Anglia. The system of characters called runes gets the name Futhorc from the first six letters,

just as the Greek system is called Alphabet from the names of the first two letters, alpha and beta, A and B, or as we call our alphabet the A B C. The following examples show the agreements and differences between British and Norse runes:



Anglo-Saxon Runes.



Norse Runes.

What is the origin of this mode of writing? Is it derived from the Greek alphabet or from the Phœnician direct? Not improbably the Phœnician manner of writing was introduced into the Baltic countries by the enterprising Phœnician traders as early as the 6th century B.C.: but though the runes are in many instances identical with characters of the Phœnician alphabet they do not represent in Futhorc the same sound values as in the alphabet of the Phœnicians: on the supposition of their derivation from that alphabet, therefore, it would be only the idea of representing voice-sounds by arbitrary written characters that would have come from the Phœnicians, not the denotations of particular sounds. Yet, though original derivation from Phœnician sources be granted, in later times Greek characters were added to complete the system.

Runjeet Singh, rūn-jēt' sīngh. See RANJIT SINGH.

Runkle, rūn'kl, John Daniel, American mathematician: b. Root, N. Y., 11 Oct. 1822; d. Southwest Harbor, Maine, 8 July 1902. He was graduated from the Lawrence Scientific School at Harvard in 1851, and having been appointed to the staff of the 'American Ephemeris and Nautical Almanac' in 1849, continued with it until 1884. He was one of the promoters of the Massachusetts Institute of Technology and held the chair of mathematics there from the time of its foundation until his retirement shortly before his death with the exception of 1870-8 when he was president. He established the 'Mathematical Monthly' in 1859 and edited it until 1861, and published: 'New Tables for Determining the Values of the Coefficients in the Perturbative Function of Planetary Motion' (1856); 'Elements of Plane and Solid Geometry' (1888); etc.

Runic Characters. See RUNES.

Runnymede, rūn'ī-mēd, England, five miles east of Windsor, in Surrey, lying along the right bank of the Thames, is the celebrated meadow where the conference was held, 15 June

RUNYON — RURAL HIGHWAYS

1215, between John and the English barons, in which the former was compelled to sign Magna Charta and the Charta de Foresta. (See JOHN.) Runnymede is now divided into several enclosures.

Run'yon, Theodore, American diplomat: b. Somerville, N. J., 25 Oct. 1822; d. Berlin, Germany, 27 Jan. 1896. He was graduated from Yale in 1842, admitted to the bar in 1846, and established a law practice at Newark, N. J. He became city attorney of Newark in 1853, city counsellor in 1856, and at the outbreak of the Civil War went to the front as brigadier-general in command of the 1st brigade of New Jersey Volunteers. He arrived at Washington on 6 May, when the threatened invasion by the Confederates had thrown the city into great alarm, and promptly took efficient measures for its defense. After the defeat of the Union army at the first battle of Bull Run when the city was in danger of invasion, he closed all approaches, stationed cannon to avert the expected attack, and thereby saved the National capital, a service for which he received the personal thanks of President Lincoln and his cabinet. He was honorably mustered out of service in July 1861 and resumed his law practice. In 1863 he was elected mayor of Newark, served as chancellor of New Jersey in 1873-87, and in 1893 was appointed minister to Germany. He was raised to the rank of ambassador in that year and remained in office until his death.

Rupee, roo-pé', in India, the name given a small silver coin. The value of this coin is nominally 50 cents, but owing to the depreciation of silver it has of late years varied between 30 and 40 cents. A rupee equals 16 annas; $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ rupee are also coined in silver. A *lac* of rupees is 100,000, and a *crore* 10,000,000 rupees.

Ru'pert, or Robert, of Bavaria, PRINCE: b. Prague 18 Dec. 1619; d. London 29 Nov. 1682. He was the son of Frederick V., elector palatine and titular king of Bohemia, by the Princess Elizabeth of England, daughter of James I., was educated at Leyden and early engaged in military service in the Thirty Years' war. During the civil war in England he had the command of a corps of cavalry, at the head of which he distinguished himself at the battle of Edgehill in 1642, at Chalgrove Field in 1643, and also at Marston Moor and at Naseby; but his impetuosity and imprudence contributed to the disastrous result of these latter engagements. In 1648 he was made commander of that part of the fleet which still adhered to Charles. Prince Rupert for some time carried on a predatory warfare against the English; but in an engagement with Blake, off the Spanish coast, he was worsted, and his whole squadron destroyed, with the exception of four or five ships, with which he escaped to the West Indies, where he supported himself by capturing English and Spanish merchantmen. Later he joined Charles II. at the court of Versailles, where his time was chiefly devoted to scientific studies till the Restoration, when he returned to England. In 1664 he was appointed with Monk, to the command of a fleet against the Dutch, and in the next war with Holland, in 1673 was made admiral of the fleet. Many useful inventions resulted from his studies,

among which are the invention of prince's metal, and although the discovery of the method of engraving in mezzotinto is not due to him, as has been erroneously supposed, he introduced the art into England. He also introduced the curious glass drops that have been named after him, Prince Rupert's drops. He was likewise one of the founders and the first governor of the Hudson's Bay Company, incorporated in 1670, and a founder of the Royal Society.

Rupert's Land, the former name of an extensive territory in Canada, conferred by Charles I. on Prince Rupert, transferred to the Hudson's Bay Company in 1670, and since 1870 included with the other parts of the Hudson Bay Territories in the Northwest Territories. The title is still retained to distinguish an Episcopalian diocese; the see of the bishop of Rupert's Land is at Winnipeg. See NORTHWEST TERRITORIES.

Ru'pia, a skin disease, characterized by an eruption of small flattened and distinct bullæ surrounded by inflamed areolæ, containing a serous, purulent, sanious, or dark bloody fluid, and followed by thick, dark-colored scabs over unhealthy ulcers. Three varieties of this disease are described, *Rupia simplex*, *Rupia prominens*, and *Rupia escharotica*. *Rupia simplex* commonly appears on the legs, sometimes on the loins or thighs, and seldom on other parts. The bullæ are not preceded by any inflammatory symptoms, vary from $\frac{1}{2}$ inch to 1 inch in diameter, and contain at first a transparent serous fluid, which soon becomes turbid and purulent, and dries into scabs. The scabs are easily removed, displaying an ulcerated surface underneath, and several series of these scabs may follow before healing sets in. In *Rupia prominens* the bullæ are larger, the scabs thicker, and the ulceration deeper. The scab adheres firmly, and generally requires emollient applications to facilitate its removal. *Rupia escharotica* occurs chiefly in cachectic children and infants. It is commonly confined to the lower extremities, and begins by one or two red and livid spots, over which the cuticle is soon raised by the effusion underneath it of a serous fluid. The bullæ thus formed increase; the serum they contain becomes turbid, and of a blackish hue. A bloody and offensive sanies marks the surface of the sore, the edges of which are livid, but not very painful. *Rupia* is chronic, not dangerous, not contagious, but often very obstinate. It generally attacks persons debilitated by age, intemperance, bad living, or previous diseases, especially smallpox, scarlet-fever, and syphilis. The general treatment consists mainly in the administration of tonic decoctions, more especially those of cinchona, cascarilla, gentian, etc., with alkalies, a generous and nutritious diet, and warm salt water and alkaline baths. The local treatment consists chiefly of puncturing the bullæ early, and allowing the morbid secretion to escape; of poulticing in order to remove the scabs, and of applying lotions containing nitrate of silver or nitric acid, or any other slightly stimulating application.

Rupture, hernia (q.v.), especially abdominal hernia, to which the term rupture is most frequently applied in popular usage.

Rural Highways. See ROADS, IMPROVEMENT OF.

RURIK — RUSH

Rurik, roo'rik, founder of the Russian monarchy: d. 879. Most writers consider him to have been a Varangian, of Scandinavian origin, though Kostomorof has endeavored to prove that he was a Lithuanian. It is recorded that he came to Russia about 862, accompanied by his brothers Sinaf and Truvor, in compliance with the request of Gostomisl, a leading personage of Novgorod. One of the brothers established himself at Belozersk, the other at Izborsk, while Rurik began by fortifying himself in the ancient town of Ladoga, at the present day a miserable village on the Volkhof. The Novgorodians soon repenting, rose in rebellion against Rurik, and at their head was one of their fellow citizens named Vadim, whose valor is celebrated in the ancient chronicles, and in Russian song. Rurik succeeded in establishing a dictatorship in Novgorod in 865, and is said to have killed Vadim with his own hand. His possessions were soon afterward greatly enlarged by the death of his brothers, whose principalities, since they died without issue, Rurik united to Novgorod. In order to secure himself and his descendants in their newly acquired territory, he invited various colonies of Varangians, on whose devotion he could count, to settle in the country. Rurik died after a reign of 17 years. The family of Rurik reigned in Russia till the death in 1598 of Feodor, son of Ivan the Terrible, when it was succeeded by the closely allied house of Romanoff.

Rus'by, Henry Hurd, American botanist and educator: b. Franklin, N. J., 26 April 1855. He was educated at the University of New York, was engaged in botanical explorations and investigations under the Smithsonian Institution in 1880-96, has been professor of botany, physiology and materia medica in the New York College of Pharmacy since 1888, and professor of materia medica at Bellevue Hospital Medical College since 1897. He is a member of many scientific societies, was curator of the New York Botanical Gardens and in 1900-1 was a member of the committee which revised the botanical department of 'United States Pharmacopœia.' His publications include: 'Essentials of Pharmacognosy' (1895); 'History of the New York College of Pharmacy' (1895); 'Morphology and History of Plants' (1899); 'Five Pamphlets on the Flora of Bolivia' (1893-1901); etc.

Rush, Benjamin, American physician: b. Byberry, near Philadelphia, Pa., 24 Dec. 1745; d. Philadelphia 19 April 1813. He was graduated from Princeton in 1760, from the University of Edinburgh in 1768, and became professor of chemistry at the College of Philadelphia in 1769. He was active in the pre-Revolutionary movements, and as member of the provincial conference of 1776 moved the resolution declaring the expediency of a declaration of independence, of which he was a signer in the following month. He was surgeon to the Pennsylvania navy in 1775-6 and in 1777 was appointed surgeon-general and later physician-general of the hospitals of the middle section. In 1778 he resigned and resumed his practice and his professorship at Philadelphia. He was a member of the convention which formed the constitution of 1780, established the first dis-

pensary in the United States in 1785, and in 1787 was a member of the convention which ratified the Federal Constitution. He became professor of theory and practice of medicine in 1789 and after the Medical College was merged in the University of Pennsylvania was appointed professor of the institutes and practice of medicine and of clinical practice. In the yellow fever epidemic of 1793 Rush instituted a new method of treatment for the disease which he used with great success, visiting from 100 to 120 patients daily. He was one of the founders of Dickinson College, an advocate of the abolition of slavery, was connected with various religious and scientific societies, and was treasurer of the United States Mint from 1799 until his death. He wrote: 'Medical Inquiries and Observations' (5 vols., 1789-98); 'Essays, Literary, Moral, and Philosophical' (1798); etc.

Rush, Richard, American diplomat: b. Philadelphia 29 Aug. 1780; d. there 3 July 1859. He was graduated from Princeton in 1797, was admitted to the bar in 1800 and engaged in practice at Philadelphia. In 1811 he was appointed attorney-general of Pennsylvania and in 1814-17 was attorney-general of the United States. He was temporary secretary of state under President Monroe in 1817 and was then appointed minister to England, a post he occupied until 1825 when he was recalled to become secretary of the treasury under President Adams. He was a candidate for the vice-presidency on the ticket with Adams in 1828 and in 1836 was appointed by President Jackson commissioner to obtain the legacy for the founding of the Smithsonian Institution which was then pending in the English chancery court, returning in 1838 with the entire amount. He was appointed minister to France in 1847 and remained such until 1851 when he was recalled at his own request and spent the remainder of his life in retirement. He published: 'Codification of the Laws of the United States' (5 vols., 1815); 'Narrative of a Residence at the Court of London from 1817 till 1825' (1833); 'Washington in Domestic Life' (1857); 'Occasional Productions, Political, Diplomatic, and Miscellaneous, including a Glance at the Court and Government of Louis Philippe, and the French Revolution of 1848' (published by his sons, 1860).

Rush, William, American sculptor: b. Philadelphia 4 July 1756; d. there 17 Jan. 1833. He was apprenticed to a carver and soon became known as a maker of figure-heads which won admiration in many ports in the world. He never worked in marble, confining himself to wood and clay, but gained a high reputation for his statues, busts, and ideal figures executed in these materials. He served in the American Revolution and was a member of the city councils of Philadelphia for more than a quarter of a century. Among the most admired of his ship carvings were: 'Genius of the United States'; 'Nature'; 'Indian Trader'; 'William Penn'; 'River God.' He also executed: 'Exhortation'; 'Praise'; busts of Linnæus, William Barton, and Lafayette; statues of 'Winter,' 'Washington' (1814); etc.

Rush. Many plants growing in moist land having cylindrical stems are called rushes, al-

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though generally with a qualifying adjective; as the bulrush (*Typha*), flowering rush (*Buto-mus*), or scouring rush (*Equisetum*), and some sedges (*Carex*). The true rushes, however, are members of the grass-like family *Juncaceæ*, containing about 200 species in the several genera, and distributed throughout the temperate zones. Some are destitute of leaves but have barren flower stems resembling leaves; some have leafy stems, the leaves rounded or somewhat compressed, and usually jointed internally; the foliage of others is very narrow, springing from the root. The round stems of the leafless species, sometimes bearing flowers, are popularly called rushes. The presence of this family in a pasture denotes bad drainage, and they are troublesome to farmers, since cattle will touch them only as a last resort. The common bog or soft rush (*Juncus effusus*) is found in wet places throughout the temperate world. It is a typical species, with glabrous tufts attaining perhaps four feet, springing from a stout rootstock, and bearing an inflorescence composed of many small greenish grass-like flowers. This species is cultivated in Japan for making mats, and with others is employed for the bottoms of chairs, baskets, coarse ropes for binding, etc. The stems of *J. conglomeratus* were formerly gathered by English farmers, and stripped of their green rind, leaving exposed a large pith with one even lengthwise rib of rind left to support it. This porous pith was then bleached and dried, and dipped in scalding grease, thus becoming the wick of a rude candle, or "rush-light," which gave a good, clear light, and, if two feet long, would burn nearly an hour. These dried rush-piths were also used in place of cotton for wicks in open lamps.

Rushes, with a few sweet herbs, were scattered before processions, and were strewn on stages in Shakespeare's time, and on the floors of houses before the advent of carpets. The strewing of rushes in the churches grew into a religious festival conducted with much pomp. These rushes on the floor generally became so filthy from overlong use that to order fresh rushes was a sincere mark of honor to a guest.

Scouring rushes are the hollow, jointed stems of the horsetail, *Equisetum hiemale*, the epidermis of which is impregnated with silica, and was formerly used for scouring metals. See DUTCH RUSH.

Bulrushes (*Typha*), or cat-tails, were somewhat employed in the place of true rushes, for mats and chair bottoms, and are also placed between barrel-staves.

Rush Medical College, located at Chicago, affiliated with the University of Chicago. It is one of the oldest educational institutions in the Northwest, having received its charter in 1837. The first lectures were delivered in 1843, and the first building erected in 1844; a larger building was erected on the same site in 1867; this was burned in the Chicago fire of 1871; and the present clinical building was erected in 1875. In 1887 the college became the Medical Department of Lake Forest University, retaining its autonomy; this relation was dissolved in April 1898, and in the same month the college was affiliated with the University of Chicago (q.v.). The government of the college is vested

in the "perpetual board of trustees" incorporated in 1837, of which the governor of the State, the lieutenant-governor, and the speaker of the house of representatives are members *ex officio*. The board has control of the financial affairs of the college and appoints the faculty; and delegates to the faculty the control of the educational work subject to the rules of the university and the approval of the trustees; by the terms of affiliation the board of trustees is composed of members not belonging to the teaching force of the college. In 1899-1900 the University offered courses corresponding to the work of the Freshman year of the Medical College, and since 1901 offers instruction in all of the courses of the first two years of the medical curriculum, in anatomy, neurology, embryology, physiology, physiological chemistry, chemistry, chemistry of medical drugs, toxicology, pathology, bacteriology and pharmacology. All the work of the first two years is offered at the university only, and the work at the college is clinical, that is, the work of the last two years of the medical course. Students who take the first-year courses matriculate and register both as students of Rush Medical College and as students of the university. Many of the courses of the Freshman and Sophomore years are required; the courses of the Junior and Senior years are all elective, a certain amount of work in each department being required for the degree of M.D. The university provides three fellowships to graduates of the college, and provides for granting the degree of B.S. to students who comply with the university requirements for that degree. The buildings of the college, distinct from those of the university, are the clinical building, Senn Hall and the laboratory building; the Presbyterian Hospital, adjoining the college, and the Cook County Hospital, opposite the college, afford material for the clinics. The library in 1904 contained over 10,000 volumes; the students in 1903-4 numbered 1,029, of whom 339 were specials and post-graduates. The college is open to women as well as men.

Rush, Scouring. See *Equisetales*, under FERNS AND FERN ALLIES; DUTCH RUSH.

Rushforth, William Henry, American inventor: b. Leeds, England, 11 July 1844; d. Rutherford, N. J., 21 Aug. 1892. He entered a railroad repair shop at 12 and at 19 had become a railroad engineer. He was chief engineer in charge of 13 stationary engines in 1874 and in 1878 came to the United States, where he became engineer in a silk factory at Camden, N. J. He was the author of numerous useful inventions, among them a fire-escape ladder, a series of automatic safety signals and a feed-water heater for utilizing the heat wasted in the smoke boxes of locomotives, the latter receiving a silver medal and a diploma at the Paris Exposition of 1887.

Rushville, Ill., city, county-seat of Schuyler County; on the Chicago, B. & Q. railroad; about 53 miles northwest of Springfield, and 48 miles east-northeast of Quincy. It was settled 20 Feb. 1826 by Benjamin Chadsey, Levi Green, and Thomas Bair, members of a commission that selected a town site. It was incorporated as a village 10 May

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1831, and chartered as a city in April 1898. It is in an agricultural and coal mining region; the chief manufactures are a flour mill, machine shop, wagon works, harness shops, bottling works, and file factory. It has considerable trade in farm products. The principal public buildings are the county court-house and the jail. There are six churches, three public graded schools, and the Rushville Normal and Business College. The two banks have a combined capital of \$150,000, with \$700,000 deposits. The government is vested in a mayor and a council of six members, who hold office for a term of two years. Pop. (1890) 2,031; (1900) 2,292; (1910) 2,370.

EDWIN DIGSON,
Editor *'Rushville Times.'*

Rushville, Ind., city, county-seat of Rush County; on Flat Rock Creek; and on the Cleveland, C., C. & St. L., the Cincinnati, H. & D., the Pittsburg, C., C. & St. L., and the Fort Wayne, C. & L. R.R.'s; about 40 miles east-southeast of Indianapolis, and 85 miles northwest of Cincinnati. It was settled in 1822, incorporated the same year, and chartered as a city in 1882. It is in a fertile agricultural region, and has considerable manufacturing interests. The chief manufactures are flour, furniture, machinery, agricultural implements, lumber, bent wood, drain pipe, clothing, clay-working machinery, and washing machines. There are nine churches, a high school, public and parish schools, two private schools, and a public library. The four banks have a combined capital of \$275,000. The government is vested in a mayor, a council of six members, elected every two years. The city owns and operates the electric light plant and the waterworks. Pop. (1910) 4,607.

Rusk, Jeremiah McLain, American agriculturist: b. Morgan County, Ohio, 17 June 1830; d. Viroqua, Wis., 21 Nov. 1893. He removed to Wisconsin in 1853, engaged in farming, became sheriff, and in 1861 was elected to the legislature. In 1862 he entered the Union army, was commissioned major, and promoted lieutenant-colonel in 1863. He commanded a regiment in Sherman's Meridian campaign and for services in the Atlanta campaign was brevetted colonel and brigadier-general in 1865. He was mustered out of service in that year and in 1866-70 served as bank-comptroller of Wisconsin. Elected to Congress in 1871 he remained there until 1877 and in 1882-9 was governor of Wisconsin. He was first secretary of the newly created Department of Agriculture under President Harrison in 1889-93.

Rusk, Thomas Jefferson, American politician: b. Camden, S. C., 8 Aug. 1802; d. Nacogdoches, Texas, 29 July 1856. He studied law, practised in Georgia, and in 1835 removed to Texas, where he took a prominent part in political affairs. He was a member of the convention which declared the independence of Texas in 1836, was its first secretary of war, and after the disablement of General Houston took command of the army at San Jacinto. He was chief justice of Texas and in 1845 president of the convention which concluded annexation with the United States. He sat in the United States Senate in 1846-56.

Ruskin, John, English critic and author: b. London 8 Feb. 1819; d. Coniston, Lancashire, 20 Jan. 1900. He attended lectures at King's College, London, was trained in drawing, and in 1836 went to Oxford, where he became a gentleman-commoner at Christ Church. In 1839, after two failures, he won the Newdigate prize for a poem on 'Salsette and Elephantia.' His first published works were essays in Loudon's 'Magazine of Natural History' on geological and allied subjects (1834 and 1836), and in 1837-8 he wrote for Loudon's 'Architectural Magazine' on 'The Poetry of Architecture' (separately published, 1893). An attack upon some of Turner's pictures in 'Blackwood's Magazine' in 1836 led him to formulate the plan of his 'Modern Painters,' the 1st volume of which appeared in 1843 as by 'A Graduate of Oxford.' The 2d volume was published in 1846, the 3d and 4th in 1856, and the 5th in 1860 (complete edition, imperial 8vo, with all the original and three new plates, six vols., 1888; 8vo edition, with reduced plates, six vols., 1897). At first intended as a defense of Turner, the work from the first assumed a wider scope, and soon became a comprehensive treatise on the principles of art. He sought to show the immense superiority of the best modern landscape-painters, especially Turner, to all the ancients, and supported the spiritual against the sensuous theory of art with an eloquence and a width of knowledge which have indeed wrought, as Sydney Smith predicted, "a complete revolution in the world of taste." The descriptions of natural scenery in the book are justly regarded as priceless gems of word-painting, and the sense of the indissoluble association of art with all other branches of human activity, so characteristic of Ruskin, became increasingly marked as the work progressed. His name was not put on the title-page till 1851.

After the publication of the 1st volume of 'Modern Painters' he continued his studies and his travels, and during a visit to Venice he definitely decided upon literature as his main work. In 1848 he married Euphemia Chalmers Gray, the 19-year-old daughter of a Scottish lawyer, for whom he had written in 1841 his fairy tale, 'The King of the Golden River' (published 1851). His married life was not very fortunate, and in 1854 the marriage was annulled, and the lady married the artist Millais in 1855. 'The Seven Lamps of Architecture' (1849) sought to do for architecture what Ruskin had already done for painting. The title and arrangement of the book are characteristic of his whole artistic criticism. All work in architecture, and in all else, should be illumined by the lamps of sacrifice, truth, power, beauty, life, memory, and obedience. In 1851 he defended Millais and Holman Hunt, two of the pre-Raphaelite leaders, in letters to the *Times*, and in the same year followed up this advocacy by a work on Pre-Raphaelitism. 'The Stones of Venice' (1851-3), the fruit of much close study and arduous toil, is a worthy companion of 'Modern Painters,' and in it, as in the earlier work, we meet the moralist as artist. The chapter 'On the Nature of Gothic Architecture,' in which his economic teaching is distinctly foreshadowed, was reprinted by

William Morris at the Kelmscott Press in 1892. In 1854 Ruskin came to know D. G. Rossetti, to whom he was a considerate and generous patron; and he was closely associated with F. D. Maurice, Furnivall, and other Christian Socialists in the work of the Working Men's College, where he taught drawing regularly for some seven years. His career as a social reformer may be dated from 1857, when he published a series of lectures on 'The Political Economy of Art' (enlarged edition, entitled 'A Joy for Ever and its Price in the Market,' 1880). His chief works of this kind are: 'Unto this Last' (1862; popular edition, 1900), originally written for the 'Cornhill Magazine'; 'Munera Pulveris' (1872), partly reprinted from 'Fraser's Magazine'; 'Time and Tide by Weare and Tyne' (1867); and 'Fors Clavigera' (1871-84), consisting of letters to the working men and laborers of Great Britain. In these the tendency to exaggeration is clearly manifest, and for a time it stood in the way of the serious consideration of his views. He laid especial stress upon the economic value of healthy, happy, honorable, self-sacrificing life; he directed attention to the vital importance of the problem of distribution and the necessity of economic co-operation; the need for a genuine national system of education, old-age pensions, and a radical solution of the housing problem was eloquently set forth by him. In this work Ruskin always professed himself a follower of Carlyle, one of his warmest friends and admirers. Some of his books published after 1855 were collections of lectures. Such are: 'The Two Paths' (1859); 'Sesame and Lilies' (1865); 'The Crown of Wild Olive' (1866); 'Work, Traffic, War, and The Future of England' (last not in first edition); and 'The Ethics of the Dust' (1866). In 1867 he delivered the Rede lecture at Cambridge on 'The Relation of National Ethics to National Art,' and was awarded the honorary degree of LL.D. by that university, and in 1893 Oxford conferred upon him its D.C.L. degree. In 1871 he was elected lord rector of St. Andrews University.

The period from 1870 till his retirement from active work was full of new schemes of social usefulness, some of them more generous in conception than practicable in execution, but all bearing eloquent testimony to the absolute sincerity of his preaching of the gospel of social righteousness and service. In 1871 he founded the Guild of Saint George, and himself paid \$35,000, a tenth of his possessions at that time, into a trust for carrying on its work. The basic principles of the guild were "that food can only be got out of the ground and happiness out of honesty," and in connection with it he started agricultural settlements, some industrial enterprises, and the Saint George's (now Ruskin) Museum at Sheffield.

In 1871 he gave up his house at Denmark Hill and purchased his well-known residence at Brantwood, on the shore of Coniston Lake. In 1870 he was appointed first Slade professor of fine arts at Oxford, and held this post till 1879, when he resigned owing to illness, and again from 1883 till 1884, when he again resigned because the university endowed vivisection. His lectures at Oxford give the best connected

account of his maturer conception of the material of the works: 'Art' (1870); 'Aratra Pentelici: on the Elements of Sculpture' (Eagle's Nest: Ten Lectures on the Natural Science to Art' (1872); 'Lectures on the Elements of Sculpture' (1873-6); 'Val d'Arno: Lectures on the Tuscan Art Directly to the Florentine Year of Victory' (The Art of England' (1884); 'Lectures on the Elements of Sculpture' (1884); and 'Lectures on the Elements of Sculpture' (1884). He founded a drawing school at it was during his professorial period he tried the famous and exceedingly road-digging experiment. In 1871 he ended the first of several attacks on and from this time his excessive unnaturally high pressure caused him to break down seriously; 1878 was the year of Whistler's libel action against him, the jury awarded one farthing damages. His most notable work of his period of mental breakdown, broken only by short journal entries, is 'Præterita: Outlines of Thoughts Perhaps Worthy of My Past Life' (1885-9), the last volume of which is 'Dilecta,' or selections from his earlier work. This fragment of autobiography contains little trace of mental decay, but a brilliant description, vivid recollection of the portraits of men whom he had known. Of works not above mentioned the most noteworthy are: 'Poems of the Past' (1851); 'The Architecture of Venice' (1851); 'On Architecture and Painting' (1851); 'On Some of the Principal Pictures in the Royal Academy' (1855-9); 'The Harbors of England' (1855); 'Gravings from drawings by Turner' (1855); 'The Drawings and Sketches of the present Exhibited in the National Gallery' (1881); 'The Elements of Drawing' (1859); 'Lectures delivered at the Working Men's College; 'Inaugural Address at the School of Art' (1858); 'The Oxford Lectures' (1859), with H. W. Acland; 'Lectures on Perspective' (1859), lectures at the Working Men's College; 'The Air' (1869), lectures on the Great cloud and storm; 'Mornings in the Garden' (1875-7; collected, 1889); 'Proserpine of Wayside Flowers' (1875-86); 'Collected Studies of the Lapse of Time' (1875-83); 'St. George's History of Venice' (1877-8); 'The Laws of Fesole: Treatise on the Elementary Principles of Drawing and Painting' (1878); 'On the Drawings by Turner Exhibited in the Fine Art Society's Galleries' (1878, 2nd edition, 1900); 'Arrows of the Centuries: a collection of newspaper letters; 'The Amiens' (1880-5); 'On the Old River: a collection of miscellaneous writings' (1880-5); a collective edition of his works but extended to only 11 volumes. He is supervising a new complete edition of his works begun in 1903 and to be finished in 1910.

RUSKIN UNIVERSITY — RUSS

There is a complete bibliography by T. J. Wise and J. P. Smart (1893). Ruskin prepared the plates, or at least the drawings, for many of his own works, and also painted some landscapes, chiefly in water color. A loan exhibition of his drawings was held in the Royal Water Color Society's rooms in 1901.

To what has already been said of the work and message of Ruskin little need be added. He was essentially a prophet, on fire with the enthusiasm of humanity, almost fierce in his opposition to every kind of insincerity and injustice. His early religious views were narrow, but in middle life he advanced to a broadly liberal position of no distinctively Christian character, though in later years he added to his religious liberalism a more definitely Christian element. What he said of 'Modern Painters' may be applied to all his work: "It declares the perfectness and eternal beauty of the work of God; and tests all work of man by concurrence with, or subjection to that." His teaching has been spread by many Ruskin societies, a Ruskin Hall for working men has been established at Oxford, and at Ruskin, Tenn., a co-operative colony was unsuccessfully attempted. Consult: Collingwood, 'Life and Work of John Ruskin' (1893); and 'Life of John Ruskin' (1900); Ritchie, 'Records of Tennyson, Ruskin, and Browning' (1892); Spielmann, 'John Ruskin' (1900); Harrison, 'Tennyson, Ruskin, Mill, and Others' (1899); Rossetti, 'Ruskin, Rossetti, and Pre-Raphaelitism' (1899); Cook, 'Studies in Ruskin' (2d ed. 1891); Hobson, 'John Ruskin, Social Reformer' (1898); Mallock, 'New Republic' (1881 — Herbert stands for Ruskin); Sizeranne, 'Ruskin et la Religion de la Beauté' (1897; Eng. trans., 1899); Smart, 'A Disciple of Plato' (1883); Waldstein, 'The Work of John Ruskin' (1894); Mather, 'Life and Teaching of John Ruskin' (5th ed., 1898); Harrison, 'John Ruskin' (1902; 'English Men of Letters,' new series); Mackail's essay in Chambers' 'Cyclopædia of English Literature' (Vol. III., 1904); Kitchin, 'Ruskin at Oxford and Other Essays' (1904).

Ruskin University, located at Glen Ellyn, Ill., a suburb of Chicago. The ideal of the institution is to unite industrial and educational work, to bring within the reach of young men and women the advantages of college education with the means of paying their own expenses chiefly from their own labor, and to teach the dignity of labor, "not as a means of livelihood only, but as the glad expression of normal life, and an absolute necessity to the acquirement of mental culture and moral character." The university had its origin in Ruskin College, established at Trenton, Mo., in 1900; it conducted there for student self-support a 2,000 acre farm, and a dairy, carried on gardening, laundering, printing, carpentering, etc., and with the co-operation of the citizens of the town established wood-working and canning factories. The larger part of the industrial equipment was not owned by the college; the college buildings also became inadequate for the increasing attendance and a new location became necessary. In January 1903 an affiliation was formed with a number of schools and colleges in Chicago under the corporate name

of Ruskin University, Ruskin College becoming the literary department of the institution; in April of that year the college was moved to Glen Ellyn. The organization of the university includes the Ruskin Industrial Guild, where employment is given in a number of occupations, printing, book-binding, cooking, laundering, horticultural and agricultural pursuits, etc. As far as possible students are given the work for which they have the most liking and aptitude. Those of the student body who become members of the Ruskin Industrial Guild are supplied with four hours of work per day on school days with an extra hour or two on Saturdays, for which they receive Ruskin script, at from 10 to 12½ cents per hour. This script they deposit in the Ruskin Industrial Bank and pay every week, their board bill and other incidental expenses, ranging from two dollars and fifty cents to three dollars per week by check upon the bank. They are required to report for duty in the industrial department just the same as for a Latin or Greek recitation, are marked by the foremen of departments as to the faithfulness in the discharge of duty and are advanced from one department to another upon the strictest sort of civil service rules. The courses offered by the University include: (1) the college preparatory course; (2) the college course, leading to the degree of bachelor of arts; (3) the normal course, leading to the degree of bachelor of pedagogy; (4) the social science course; the completion of which with work in other courses equal to the requirements of the college course, entitles the student to the degree of bachelor of social science; (5) special courses in bookkeeping and stenography, music, art, oratory, dressmaking, telegraphy, and domestic science; (6) the business course, leading to the degree of bachelor of accounts; (7) professional courses in law, medicine, dentistry, pharmacy, or the art craft, at the affiliated schools in Chicago; (8) correspondence courses. The college course is entirely elective and may be completed in three years; the completion of the special courses counts for a certain amount of credit toward the degree. The students in the college department at Glen Ellyn number about 300, and the members of the faculty 15.

Rusling, James Fowler, American soldier: b. Washington, N. J., 14 April 1834. He was graduated from Dickinson College in 1854 and was professor there until 1857, when he engaged in law practice. At the outbreak of the Civil War he entered the Union army with rank as lieutenant. He served in the Army of the Potomac in 1861-3, in the Department of the Cumberland in 1863-5, and in the war department in 1865-7. He attained rank as colonel of volunteers in 1865, was brevetted brigadier-general in 1866 and mustered out of service in 1867. He was United States pension agent for New Jersey in 1868-77 and has published: 'Across America, or the Great West and Pacific Coast' (1874); 'History of Pennington Seminary' (1890); 'Men and Things I Saw in Civil War Days' (1899); 'European Days and Ways' (1902); etc.

Russ, John Denison, American physician and philanthropist: b. Chebacco (Essex), Mass.

RUSSELL

1 Sept. 1801; d. Pompton, N. J., 1 March 1881. He was graduated from Yale in 1823, studied medicine in the United States, in London, and on the Continent, in 1826 began practice in New York, in 1827-30 was in Greece aiding the patriots, and upon his return began the first instruction of the blind attempted in the United States. He was invited to organize the Institution for the Blind in Boston, but preferred to continue his independent work. In 1832 he became superintendent of the New York institution, a post which he resigned in 1858. His inventions and improvements for the assistance of the blind were widely used. Latterly he was active in endeavors to improve prison discipline and further the welfare of discharged prisoners.

Russell, rüs'el, Addison Peale, American author: b. Wilmington, Ohio, 8 Sept. 1826. He rose from a printer's apprentice to be an editor and publisher, was elected to the Ohio legislature in 1855 and in 1857-61 was secretary of state for Ohio. He has published: 'Half Tints' (1867); 'Thomas Corwin' (1882); 'Characteristics' (1883); 'In a Club Corner' (1890); 'A Club of One' (1887); 'Sub-Cœlum' (1893); 'Library Notes' (1875-9).

Russell, Benjamin, American journalist: b. Boston, Mass., 13 Sept. 1761; d. there 4 Jan. 1845. He was apprenticed to Isaiah Thomas, publisher of the Worcester, Mass., 'Spy,' but entered the Revolutionary army before completing his apprenticeship, and there collected war news for that paper. In 1784 he established the 'Columbian Sentinel,' which he made the most powerful organ of the Federal party in New England, and which he edited until 1828. He also established and conducted in 1795-1830 the 'Gazette,' likewise a Federalist organ. He printed the laws and state documents during the first sessions of Congress and refused to receive pay for his work until it was pressed upon him by Washington; represented Boston in the general court for 24 years; served several terms in the Massachusetts senate; was a member of the executive council, and of the Constitutional convention in 1820.

Russell, Sir Charles Arthur, BARON OF KILLOWEN, English jurist: b. Newry, Ireland, 10 Nov. 1832; d. London 10 Aug. 1900. He began his career as solicitor in 1854, later matriculated at Trinity College, Dublin, but did not graduate; and in 1856 removed to London, entered Lincoln's Inn and was admitted to the English bar in 1859. In 1872 he was made Queen's counsel, and entered Parliament for Dundalk in 1880, but his part in debate was largely confined to questions concerning Ireland. In 1885 he was returned for South Hackney and became attorney-general in Gladstone's cabinet in 1886. His speeches in behalf of home rule were his most notable parliamentary achievements. He was leading counsel for Parnell in the investigations brought about by the Parnell Commission Act of 1888, and his six days' speech concluding the trial on 12 April 1889 is accounted his greatest forensic effort. He defended the prisoner in the Maybrick murder trial; in 1893 represented Great Britain in the Bering Sea arbitration; in 1894 was made lord of appeal; was raised to a life-peerage as baron

of Killowen, and later succeeded Lord Coleridge as lord chief justice. In 1896 he delivered an address before the American Bar Association at Saratoga, on 'Arbitration: its Origin, History and Progress.' In 1899 he succeeded Lord Herschell as one of the arbitrators to determine the boundaries between British Guiana and Venezuela. His publications aside from his address on arbitration were mainly contributions to current discussions.

Russell, David Allen, American soldier: b. Salem, N. Y., 10 Dec. 1820; d. near Winchester, Va., 19 Sept. 1864. He was graduated from West Point in 1845, served in the Mexican War and in 1847 was brevetted 1st lieutenant for gallant conduct. He subsequently served on the Pacific coast, was brevetted captain in 1854, and at the outbreak of the Civil War was assigned to aid in the defense of Washington. In 1862 he was appointed colonel and served in the Peninsular campaign under McClellan. He commanded a brigade in the Rappahannock campaign, was brevetted colonel in the regular army, assisted in the capture of the Rappahannock station and commanded a division at the battles of the Wilderness, Spottsylvania, and North Anna. He was engaged in the defense of Washington in August and September 1864, and was killed while leading his column at Opequan, Va., 19 Sept. 1864. He was brevetted major-general of regular army the same day.

Russell, Henry Benajah, American journalist: b. Russell, Mass., 9 March 1859. He was graduated from Amherst in 1881, was attached to the New York *Sun* 1884-8, was on the editorial staff of the Providence *Journal* 1888-90, and of the Hartford *Post* 1890-7. He has published 'Life of William McKinley' (1896); 'International Monetary Conferences' (1898); 'Our War with Spain' (1899).

Russell, Israel Cook, American geologist: b. near Garrattsville, N. Y., 10 Dec. 1852; d. Ann Arbor, Mich., 1 May 1906. He was educated at the College of the City of New York and Columbia School of Mines, and accompanied the United States expedition to New Zealand to observe the transit of Venus. In 1875 he became assistant professor of geology at Columbia and from 1880 was attached to the United States geological survey, for which he made surveys in the Rocky Mountains, Southern Appalachian regions, and in Alaska. In 1879 he ascended the Yukon and made his way to Lynn Canal, and in 1890-1 led expeditions to Mount Saint Elias. In 1892 he became professor of geology at the University of Michigan. His contributions to geography and geology embrace 'Geological Reconnaissance in Central Oregon' (1883); 'Geological History of Lake Lahontan' (1885); 'Quaternary History of Mono Valley, California' (1887); 'Existing Glaciers of the United States' (1889); 'Sub-aerial Decay of Rocks' (1889); 'A Second Expedition to Mount Saint Elias' (1892); 'A Geological Reconnaissance in Central Washington' (1893); 'Lakes of North America' (1895); 'Present and Extinct Lakes of Nevada' (1895); 'Glaciers of North America' (1897); 'Volcanoes of North America' (1897); 'Rivers of North America' (1898).

Russell, James Earl, American educator: b. Hamden, N. Y., 1 July 1864. He was graduated from Cornell in 1887, studied at the

RUSSELL

universities of Jena, Leipsic, and Berlin, and in 1895-7 occupied the chair of philosophy and pedagogy at the University of Colorado. He was appointed professor of education at the Teachers' College, Columbia University, in 1897, and since 1898 has been dean of that college. He has published: 'The Extension of University Teaching in England and America' (1895); 'The History, Organization, and Methods of Secondary Education in Germany' (1899); etc.

Russell, John, 1ST EARL RUSSELL, English statesman, 3d son of John, 6th Duke of Bedford: b. London 18 Aug. 1792; d. Richmond Park, Surrey, 28 May 1878. He was educated at Edinburgh University, where he trained himself to debate at the meetings of the Speculative Society. In July 1813 he entered Parliament and soon gained prominence among the politicians of the day. He early took up the subject of parliamentary reform, and supported the repeal of the Test and Corporation Acts, and Roman Catholic emancipation. In 1828 he had the satisfaction of seeing the Test and Corporation Acts repealed by the Wellington ministry, and in April 1829 the Catholic Relief Bill became law. When the Grey cabinet was formed in 1830 Lord John Russell, then paymaster-general of the forces, was elected one of a committee of five to formulate a Reform Bill. This was brought before the House of Commons 1 March 1831 by him, and though he defended it clause by clause with extraordinary vigor, it was ultimately rejected. Upon this the Whig ministry resigned, and an appeal made to the country. The elections resulted in a majority favorable to the bill, which received the royal sanction 7 June 1832. In Lord Melbourne's second cabinet (1835-41) he was at first home secretary and then colonial secretary, and on the outbreak of the Canadian rebellion, by recognizing the right of the colonists to self-government, reconciled them to the mother country. From 1841 (in which year he became member for the city of London) to 1845, during the Peel administration, Lord John Russell led the opposition, but lent his influence in favor of the repeal of the corn-laws. He was premier 1846-52, and was able to pass his Ecclesiastical Titles Bill of 1851, prohibiting the assumption of the territorial titles by Roman Catholic bishops. Lord Derby who followed him soon resigned and under the succeeding administration of Lord Aberdeen, Russell was foreign secretary for a short time. He also filled the post of lord-president of the council from June 1854 to February 1855. He was colonial secretary under Lord Palmerston in 1855, and represented Great Britain at the Vienna conferences; but his conduct of the negotiations brought him so much unpopularity that he resigned in July of that year. When Palmerston returned to power in 1859 Lord John again became foreign secretary, with a seat in the cabinet. He took a leading part in regard to such political questions as the oppression of the Poles by Russia, the aggressive policy of German powers toward Denmark, and the disputes between England and the United States as to the neutrality observed during the continuance of the Civil War. He retained his seat for the city of London from June 1841 till July 1861, when he was raised to the peerage as Earl Russell. After the death of Lord Palm-

erston 18 Oct. 1865 Earl Russell became prime minister for the second time, Gladstone taking the lead in the House of Commons. During the session of 1866, in conjunction with Gladstone, he introduced a new Reform Bill, which failing to pass the ministry, resigned, and was succeeded by that of Lord Derby. Thenceforth Earl Russell held no office in any ministry, though he always took an active part in promoting Liberal measures.

He published among other works: 'History of the British Constitution' (1821); 'Essay on the History of the English Government' (1823); 'Memoirs of the Affairs of Europe' (1824-9); 'Essay on the Causes of the French Revolution' (1832); 'Memoirs and Correspondence of Thomas Moore' (1852-6); 'The Life and Times of Charles Fox' (1859-66); 'Selections from Speeches of Earl Russell, 1859 to 1865'; 'Recollections and Suggestions, 1813-73' (1875). Consult: Walpole, 'Life of Lord John Russell' (1889); Reid, 'Lord John Russell' (1895).

Russell, John Edwards, American politician: b. Greenfield, Mass., 30 Jan. 1834; d. Leicester, Mass., 27 Oct. 1903. He was engaged in business in South America in 1857-63, and after his return to New York was interested with Benjamin Holliday in the Overland Mail enterprise. He was secretary of the Massachusetts State Board of Agriculture in 1880-7 and in the latter year was elected to Congress, but declined a renomination. He continued active in politics, but held no further public office.

Russell, John Scott, Scottish engineer and naval architect: b. Glasgow 8 May 1808; d. Ventnor, Isle of Wight, 8 June 1882. He was educated at the universities of Edinburgh, Saint Andrews, and Glasgow, graduating from the latter at 16. In 1832 he was professor of natural philosophy in Edinburgh University. During his researches into the nature of waves he discovered the existence of the wave of translation, on which he founded the wave-line system of construction of ships introduced into practice in 1835. In 1844 he removed to London, and was for many years a well-known shipbuilder on the Thames. He became joint-secretary of the Royal Commissioners for carrying out the Great Exhibition of 1851, and took a leading part in organizing it. He built the Great Eastern; was joint-designer of the first English sea-going armored frigate, the Warrior, and constructed the vast dome of the Vienna Exhibition of 1873. He published: 'The Modern System of Naval Architecture for Commerce and War' (1864-5); 'Systematic Technical Training for the English People' (1869); and 'The Wave of Translation in the Ocean of Water, Air, and Ether' (new ed. 1885).

Russell, Lillian (HELEN LOUISE LEONARD), American comic opera singer: b. Clinton, Iowa, December 1861. She sang in 'Pinafore' under E. E. Rice in 1879, and later appeared in New York at Tony Pastor's theatre. She soon became the star in the McCaull Opera Company and played leading parts in 'Snake Charmer,' 'Oli-vette,' 'Patience,' and 'The Sorcerer.' She sang in London in 1883 and returned to New York in 1885, from which date until 1891 she sang at the Casino in various roles. She retains



RUSSELL — RUSSELLVILLE

the Danish war of 1864, the Prusso-Austrian war 1866, and the Franco-German war of 1870. He accompanied the Prince of Wales to Egypt in 1868 and was his honorary private secretary on his visit to India in 1875. In 1879-80 he was again engaged as war correspondent in South Africa, and in 1883-4 was on that duty in Egypt. He was knighted in 1895 and was editor of the 'Army and Navy Gazette.' His publications include: 'British Expedition to Crimea'; 'Diary in India'; 'My Diary — North and South' (1863); 'The Prince of Wales Tour' (1877); 'Hesperothen' (1882); 'The Great War with Russia' (1895); 'Toloben's Sebastopol'; etc.

Russell, House of, English noble family presumed to have descended from Turstain, a Scandinavian jarl who settled in Normandy after its conquest by the Normen, and became possessed of the Castle of Rozel, near Caen. The name of HUGH DE ROZEL appears in a charter of Matilda, the wife of William the Conqueror, dated 1066; and also with that of his elder brother, on the roll of Battle Abbey. Both accompanied Robert of Normandy in the first crusade. The elder died there, but Hugh returned and settled in England. A descendant of his, JOHN ROZEL or RUSSELL, as the name had now begun to be written, was constable of Corfe Castle about 1221; and another WILLIAM RUSSELL represented Southampton in the first Parliament of Edward II. SIR JOHN RUSSELL, a direct descendant of the last named, was speaker of the House of Commons in Henry VI.'s reign. His grandson, SIR JOHN, was in favor with Henry VIII. The lands of the Abbey at Tavistock, and of the dissolved monastery at Woburn, were conferred on him, and he was made 1st Earl of Bedford. His son, the 2d earl, died without issue, and the title passed into another branch of the Russell family. WILLIAM RUSSELL, 5th earl, was created Marquis of Tavistock and Duke of Bedford in 1694. A notable member of the family was ADMIRAL EDWARD RUSSELL, who distinguished himself by his victory over the French fleet at La Hogue in 1692. JOHN, 4th duke (b. 1710; d. 1771), held office in the Newcastle and Grenville ministries, and was lord-lieutenant of Ireland in 1756-62. FRANCIS, 5th duke (1765-1802), was distinguished for his services to agriculture. FRANCIS, 7th duke (b. 1788; d. 1861), was summoned to the House of Lords in 1832, before the death of his father. He held no political office, but like most members of the family gave staunch support to the Whigs. The 9th duke, FRANCIS, was succeeded by his son GEORGE, the 10th duke, in 1891, and he by his brother HERBRAND in 1893.

Russell's Viper, one of the largest and most venomous serpents (*Daboia russelli*) of the East Indian region; justly dreaded throughout southern and eastern India, Ceylon, Burma, and Siam. It may reach a length of five feet, and is yellowish-brown with three longitudinal series of black, light-edged rings, which sometimes encircle reddish spots. It is known also as chain-viper, tic-palanga (Ceylon), etc., and is regarded by experts as the most deadly in India, but fortunately it is neither as numerous nor as easily provoked as the cobra. According to Fayer it is nocturnal in its habits, sluggish

and does not readily strike unless irritated, when it bites with great fury; moreover its loud hissing when disturbed is likely to give one sufficient warning to enable him to jump out of reach of its fangs. It is said to kill many grazing cattle. The action of its poison resembles that of the rattlesnake, but gives rise to hemorrhagic extravasations from the kidneys and various other organs. Consult: Fayer, 'Thanatophidia of India' (1874); Gadow, 'Amphibia and Reptiles' (1901).

Rus'sellville, Ark., town, county-seat of Pope County; on the St. Louis, I. M. & S. and the Dardanelle & R. R.R.s; about 80 miles northwest of Little Rock. It is in an agricultural region in which the chief product is cotton. The lumber interests are quite important. The chief manufactures are cotton and lumber products, flour, dairy products, and agricultural implements. The two banks, one national and one state, have a combined capital of \$80,000. Pop. (1910) 2,936.

Russellville, Ky., city, county-seat of Logan County; on the Louisville & Nashville railroad; about 25 miles west-southwest of Bowling Green and 52 miles north by west of Nashville. It is in an agricultural region in which tobacco is one of the chief products. The chief manufacturing establishments are flour mills, tobacco factories, wagon and carriage works, and furniture factories. It contains the Logan Female College (M. E. S.), established in 1867, the Bethel College (Baptist), founded in 1854, public schools and a public library. The three state banks have a combined capital of \$175,000. Pop. (1910) 2,690.

Rus'sellville, Engagements at. After the defeat of Gen. W. E. Jones at Morristown, Tenn. (q.v.), 10 Dec. 1863 he was followed by a Union force under Col. Graham, and when near Russellville Graham ran into Gen. Morgan's cavalry division, which was foraging. He was attacked and driven back, leaving some dead, wounded, and prisoners in the hands of the Confederates. Late in October 1864 Col. J. B. Palmer, 58th North Carolina, with about 800 men and 3 guns, moved from North Carolina into East Tennessee to co-operate with the Confederate troops under Gen. Vaughn, and 28 October he was ordered by Vaughn to take position in rear of Russellville, on the Bull's Gap road. He had scarcely taken position when Vaughn's brigade, defeated at Morristown, swept past him in great disorder. He formed line, threw out skirmishers, and opened fire with his three guns upon Gillem's pursuing troops, checking them and enabling Vaughn to rally about 200 of his men. Gen. Gillem, who, with a brigade, was at Henderson's Depot on 8 Nov. 1864, hearing that Gen. Breckinridge was advancing to reconquer East Tennessee, fell back to Greeneville on the 9th and to Bull's Gap on the 10th, where he was attacked on the morning of the 11th by Gen. Duke's cavalry brigade, and held his own during the day. The attack was renewed by Breckinridge on the 12th with artillery; he next assaulted in front and in rear with cavalry, both being repulsed. Breckinridge again renewed the attack on the 13th, and kept it up all day. Gillem, being now almost out of ammunition, and without food for his men and forage for his horses, abandoned his position during the night and fell back toward





RUSSIA IN EUROPE

SCALE OF MILES.

Population of places is indicated by different lettering, thus:
100,000 and over.

Russellville. He took position on the road, at its intersection with the Knoxville and Greenville road, intending to hold that point until his trains had passed it. Nearly all his trains had passed, and were going through Russellville, when, on the 14th, his rear was attacked by Breckinridge with the brigades of Duke and Vaughn. His men were thrown into disorder, became panic-stricken, could not be rallied, and retreated through Russellville to Strawberry Plains. He had 41 killed and wounded, and lost six guns, 132 wagons and ambulances, and 300 horses. About 200 of his men were captured. Consult 'Official Records,' Vols. XXXI. and XXXIX.

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Russia, an extensive empire comprising the whole of eastern Europe from about 17° 40' east, and stretching continuously for about 170 degrees over the whole continent of Asia to Bering Strait, or nearly half of the circuit of the world. The boundaries are the Arctic Ocean on the north, Bering Strait and Bering Sea on the east, the Pacific Ocean, Chinese Empire, Afghanistan, Persia, Asiatic Turkey, and the Black Sea on the south, and Rumania, Austria-Hungary, Germany, the Baltic Sea, and Sweden on the west. The length east to west is estimated at about 7,000 miles; the average breadth north to south is about 1,500 miles. The whole area is officially given at 8,660,395 square miles, approximately twice the area of Europe, and one sixth of the land surface of the globe. The empire consists of several well defined parts; in Europe, Poland and Finland (qq.v.), besides European Russia, the latter although less than a fourth of the whole, including nearly three fourths of the entire population; in Asia—northern Caucasia, Transcaucasia, the Steppes, Turkestan, the Caspian and Transcasian, and Siberia. The appended table gives the official divisions of the empire, their area, population, and the density per square mile of land; the areas occupied by water are included in the total, but the densities of the population are calculated on the land area.

GOVERNMENT OR PROVINCE	Area: English sq. miles	Domiciled Population	Density per sq. mile
1. European Russia—			
Archangel	331,640	347,589	1
Astrakhan	91,327	994,775	11
Bessarabia	17,619	1,933,436	113
Chernigov	20,233	2,321,900	115
Courland	10,535	672,634	64
Don, Region of the	63,532	2,575,818	41
Ekaterinoslav	24,478	2,112,651	86
Esthonia	7,818	413,724	54
Grodno	14,931	1,617,359	109
Kaluga	11,942	1,185,726	99
Kazan	24,601	2,191,058	89
Kiev	19,691	3,576,125	181
Kostroma	32,490	1,429,228	44
Kovno	15,692	1,549,444	100
Kursk	17,937	2,396,577	134
Kharkov	21,041	2,509,811	119
Kherson	27,523	2,732,832	100
Livonia	18,158	1,300,640	74
Minsk	35,293	2,156,123	61
Mogilev	18,551	1,708,041	92
Moscow	12,859	2,433,356	189
Nijni-Novgorod	19,797	1,600,034	81
Novgorod	47,236	1,392,933	33
Olonez	57,439	366,715	7
Orel	18,042	2,054,749	114
Orenburg	73,816	1,609,388	22
Penza	14,997	1,491,215	99
Perm	128,211	3,003,208	24

GOVERNMENT OR PROVINCE	Area: English sq. miles	Domiciled Population	Density per sq. mile
Podolia	16,224	3,031,513	187
Poltava	19,265	2,794,727	145
Pskov	17,069	1,136,540	68
Ryazan	16,255	1,827,539	113
Saint Petersburg	20,760	2,107,691	123
Samara	58,321	2,763,478	46
Saratov	32,624	2,419,884	74
Simbirsk	19,110	1,549,461	81
Smolensk	21,638	1,551,068	72
Tambov	25,710	2,715,453	106
Taurida	24,497	1,443,566	62
Tula	11,954	1,432,743	120
Tver	25,225	1,812,825	73
Ufa	47,112	1,220,497	47
Vilna	16,421	1,591,912	98
Vitebsk	17,440	1,502,916	89
Vladimir	18,864	1,570,733	84
Volhynia	27,743	2,997,902	109
Vologda	155,498	1,365,587	9
Voronezh	25,443	2,546,255	109
Vyatka	59,329	3,082,788	52
Yaroslav	13,751	1,072,478	78
Sea of Azov	14,520	.....	.....
Total Russian Provinces ..	1,902,202	94,215,415	51
2. Vistula Prov.—			
Kalisz	4,392	846,719	194
Kielce	3,897	763,746	196
Lomza	4,667	585,781	144
Lublin	6,501	1,159,463	177
Piotrkow	4,729	1,409,044	297
Plock	4,200	556,877	153
Radom	4,769	820,363	171
Siedlce	5,335	775,316	140
Suwalki	4,846	604,945	127
Warsaw	5,523	1,933,689	286
Total, Poland ..	49,159	9,455,943	193
Total, Russia and Poland ..	1,951,361	103,671,358	53
3. Grand-duchy of Finland—			
Abo-Björneborg	9,333	430,194	47
Kuopio	16,499	305,166	22
Nyland	4,584	276,335	61
St. Michel	8,819	186,478	28
Tavastehus	8,334	285,281	40
Uleaborg	63,957	268,226	4
Viborg	13,530	394,412	33
Vasa	16,105	446,772	30
Lake Ladoga	3,094	.....	.....
Total Finland ..	144,255	2,592,778	20
Total European Russia	2,095,616	106,264,136	51
4. Caucasus—			
Kuban	36,441	1,922,773	54
Stavropol	23,398	876,298	38
Terek	26,822	933,485	35
Baku	86,661	3,732,556	43
Black Sea	15,095	789,659	55
Daghestan	2,836	54,228	.....
Elizabethpol	11,332	586,636	58
Erivan	16,721	871,557	52
Kars	10,075	804,757	101
Kutais	7,308	292,498	43
Tiflis with Zakataly	13,968	1,075,861	54
Total, Caucasus	180,843	9,248,695	54
Akmolinsk	229,609	678,957	3
Semipalatinsk	184,631	685,197	4
Turgai	176,219	453,123	3
Uralsk	139,168	644,001	4
Lake Aral	26,166	.....	.....
The Steppes	755,793	2,461,278	3
Samarcand	26,627	857,847	39
Ferganah	35,654	1,560,411	43

RUSSIA

GOVERNMENT OR PROVINCE	Area: English sq. miles	Domiciled Population	Density per sq. mile
Syr-Daria	194,853	1,479,848	7
Semirychensk ..	152,280	990,107	7
Turkestan	409,434	4,888,183	12
Trans-Caspian ...	214,237	372,193	2
Caspian Sea	169,381	.....	.....
Total, Central Asian domin- ions	1,548,825	7,721,684	5
Tobolsk	539,659	1,438,484	3
Tomsk	331,159	1,929,092	6
Western Siberia ..	870,818	3,367,576	4
Irkutsk	287,061	506,517	2
Transbaikalia	236,868	664,071	3
Yakutsk	1,533,397	261,731	2
Yeniseisk	987,186	559,902	1
Eastern Siberia ..	3,044,512	1,992,221	7
Amur Region ...	888,830	339,127	3
Sakhalin	29,336	28,166	1
Total, Siberia...	4,833,496	5,727,090	1
Total, Asiatic dominions ...	6,564,778	22,697,469	4
Russians in Fin- land, Bokhara, Khiva, and in the navy abroad	.....	42,909	.....
Grand total ...	8,660,395	129,004,514	15

Imperial expansion in Asia has been a marked feature of Russian policy since the 18th century. The first settlements on the Pacific slope were established on the Sea of Okhotsk, and by 1859 the boundaries were pushed so far south as the Amur River. In North America, Russia had extended its sovereignty over the Alaskan Peninsula, which, however, it sold in 1867 to the United States for \$7,200,000. (See ALASKA and ALASKAN BOUNDARY COMMISSION.) In 1872 it compelled Khiva (q.v.) to acknowledge the suzerainty of the Czar, and in the following year Bokhara (q.v.), on which pressure had been brought to bear since 1850, and which had been invaded in 1866, became practically a Russian dependency. In 1875, the island of Sakhalin in the Sea of Okhotsk, north of Japan, was ceded to Russia by the Japanese. In 1898, after Japan's successful war with China, Russia obtained from Japan a lease of the Liao-tung peninsula, with the important ports of Dalny and Port Arthur (qq.v.), and after the Boxer uprising of 1901, occupied Manchuria (q.v.). Meanwhile Armenia had been partly absorbed; Russian influence had been strongly established in the Mongolian steppes, and the military outposts in Turkestan had been extended southward in the Pamirs.

The largest cities of European Russia are the capital, Saint Petersburg, 1,267,023; Moscow, 988,614; Warsaw, 638,209; Odessa, 405,041; Lodz, 315,209; Riga, 256,197; Kiev, 247,432; Kharkov, 174,846; Vilna, 154,532; Saratov, 137,109; Kazan, 131,508; Ekaterinoslav, 121,216; Rostov-on-the-Don, 119,889; Astrakhan, 112,880; Tula, 111,048; Kishinev, 108,796; Nijni-Novgorod, 95,124. The cities of Asiatic Russia above 100,000 population are Tiflis, 160,645; Tashkend, 156,414; and Baku, 112,253.

The continuity of the empire might appear to demand a detailed description in a single article; but its immense magnitude, and the distinct names commonly used to designate the different portions, make it more convenient to consider them separately under the heads of European Russia, and Siberia and Asiatic Russia. See article SIBERIA AND ASIATIC RUSSIA.

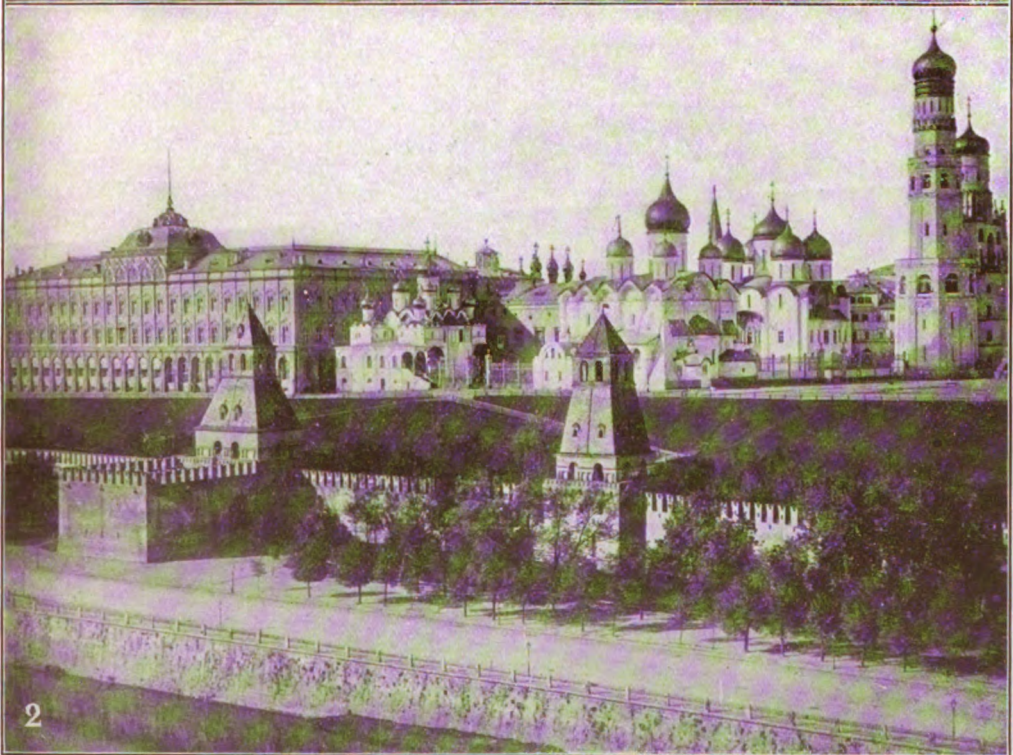
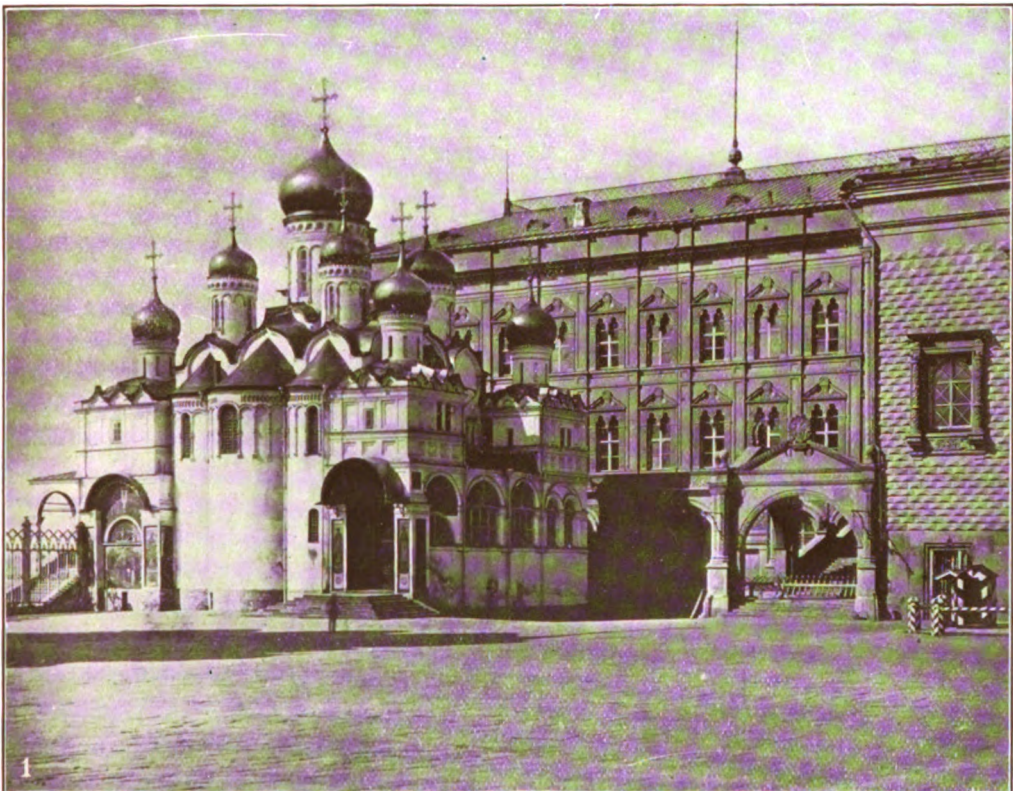
EUROPEAN RUSSIA.

Various classifications, partly historical and partly geographical, of the numerous divisions of European Russia, besides Poland and Finland, include Great Russia, Little Russia, South Russia, West Russia, the Baltic Provinces, and Caucasus.

The boundaries of European Russia on the north and west are the same as those given above for the empire. Its southern boundaries also are the same as far east as the eastern shores of the Caspian Sea. The eastern boundary is not so well defined. In its northern part the Ural Mountains form such a definite, natural barrier that their title to fix the frontiers of Europe and Asia, so far at least as the governments Archangel and Vologda extend, has been almost universally recognized. To the south of this the boundary may be said to be almost arbitrary, but is generally conceded to follow the Ural chain southward till it reaches the sources of the river Ural, and then follow the course of this river to its mouth in the Caspian. Parts of the governments of Perm and Orenburg, however, extend across the Ural Mountains, and are therefore in Asia. European Russia, as thus defined, is bounded northeast by the Ural Mountains, east by the government of Tobolsk, the steppes of the Kirghiz, and the Caspian Sea.

Topography.—The surface, in the most general view that can be taken of it, is two immense plains, the boundary between which is marked, though not very definitely, by a broad central ridge which stretches across it in an irregular waving line, mainly in a northeast direction, commencing on the frontiers of Poland, and terminating on the west side of the Ural Mountains, near lat. 62° N. This ridge forms the eastern continuation of the great watershed which divides the whole continent of Europe into a north and a south basin; but, unlike the west part, which is composed of lofty mountain chains or elevated plateaus, is only of moderate height, never exceeding 1,000 feet above sea-level. Even this height is attained only in the Valdai Hills, the far greater part of which, and of the remainder of the ridge, has an average height of not more than 500 feet. The only regions where the surface assumes a mountainous appearance are in the east, where the Ural chain, though nowhere much exceeding 5,000 feet, looks more elevated, at least in its northern part, from its high latitude and consequent covering of perpetual snow; and in the south, where the Mountains of the Yaila chain, lining the southern shores of the Crimea, have a height of about 4,000 feet. With these exceptions the only other parts of European Russia which, according to the limits above assigned to it, do not belong to its two immense plains, are those districts of Perm and Orenburg which are situated on the east side of the Urals, and slope toward the almost boundless steppes of Asia. The coast-

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1. The Cathedral of the Annunciation, Moscow.

2. The Kremlin, Moscow.

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Line of European Russia was confined to the Arctic Ocean until the end of the 17th century, and it was only by conquest that Russia obtained a seaboard on the Baltic and the Black Sea; the latter, however, remains practically an inland sea, the entrance to which is in the hands of Turkey. The Arctic Ocean, affording excellent fishing grounds in the western portion, makes, with the White Sea, a deep indentation on the north coast, but its gulfs, Kandalaksha, Onega, and Dvina, are ice-bound for nine months every year. Archangel, the chief port, is comparatively unimportant. Farther east, Cheskaya and Pechora bays are surrounded by frozen deserts. The Kara Sea, between the crescent-shaped island of Nova Zembla and the coast of Siberia, is navigable for a few weeks only every year. The islands of Kolgueff, Vaigatch, Nova Zembla, and the islands of Siberia are uninhabited. The Baltic Sea, with the Gulfs of Bothnia, Finland, and Riga, is the chief sea of Russia; but it nowhere touches purely Russian territory, its coasts being peopled by Finns, Letts, Esthonians, and Germans. Nevertheless, four out of the five chief ports of Russia—Saint Petersburg, Reval, Libau, and Riga—are situated on the Baltic Sea. Three of them are frozen during four to five months every year; and Libau is the only one which has its roadsteads open nearly all the year round. The chief islands of the Baltic are the Åland archipelago, belonging to Finland; Dagö, Osel, Mohn, and Worms at the entrance of the Gulf of Riga; Hochland and Kotlin (with the fortress of Cronstadt) in the Gulf of Finland.

The Black Sea acquires more and more importance every year. The fertile steppes of its littoral are being rapidly settled, and the centre of gravity of Russia's population is gradually shifting south. The Black Sea suffers, however, from a lack of good ports. Its great gulf, the Sea of Azov (ports Taganrog and Rostoff), is very shallow; the fine ports of the Crimea are too remote from the mainland; and the seaboard of Northern Caucasus is separated from the interior by a high chain of mountains. Odessa is the chief port of this sea; and it has no rival in Russia except Saint Petersburg. Nikolaiev is the principal naval arsenal; and Sebastopol remains a naval station. Batum, the chief port of Transcaucasia, is of great importance for the export of petroleum. The Caspian Sea, which receives the chief river of European Russia—the Volga—is a valuable medium of communication between the central Asian dominions of the empire and the Caucasus, as also for trade with Persia (to which the south coast belongs); but it has no outlet to the ocean, nor is there any probability of connecting it advantageously by canal with the Black Sea, its level being 70 feet below sea-level.

Hydrography.—The rivers are remarkable for their number and magnitude. The broad central ridge already referred to forms the great water-shed of the country, sending the waters on its north side either to the Arctic Ocean or Baltic Sea, and those on the south side to the Black Sea or the Caspian, thus forming four distinct basins. The Arctic Ocean receives directly the Pechora, which drains chiefly the western slopes of the Ural Mountains by a number of important affluents, accumulates them into one great flood, which then flows almost due north, and empties

itself into a wide estuary remarkable for the number of islands which the alluvial deposits of the river have formed within it. Through the White Sea, the Arctic Ocean receives the waters of the Mezen, Northern Dvina, and Onega. The most important of the three is the Dvina, which, receiving its supplies in nearly equal quantities from the east of the Vitchegda, and from the west by the Suchona, proceeds northwest in a circuitous course, continually augmented by large affluents, and falls into the Gulf of Archangel, a little below the well-known port of that name. The surface drained by the rivers of this basin is almost entirely confined to the two extensive governments of Archangel and Vologda. The basin next in order is that of the Baltic. Its principal rivers are the Kemi and Tornea (the latter common to both Russia and Sweden), which fall into the Gulf of Bothnia; the Kymmene, Neva, and Narva or Narowa, which fall into the Gulf of Finland; the Aa and Düna or Western Dvina, which fall into the Gulf of Riga; the Niemen or Memel, which enters Prussia before terminating its course; and the West Bug, an affluent of the Vistula. To the basin of the Black Sea belong the Dniester, South Bug, and Dnieper, which have all their mouths at a short distance from each other in the neighborhood of the rising seaport of Odessa; the Don, which falls into the northeast extremity of the Sea of Azov; and the Kuban, which derives its chief supplies from Circassia. The last basin, that of the Caspian, is in some respects the most remarkable of all, since, though Europe sends it only two large rivers, the Ural and the Volga, both supplied in part from Asiatic sources, the latter not only surpasses all other Russian rivers, but is one of the greatest of Europe. The lakes of Russia are on a scale of magnificence commensurate with that of the rivers. To say nothing of the Caspian, which, being wholly surrounded by land, and even incapable from the lowness of its level, of discharging itself into any other sea, is truly a lake—Russia has others of vast extent. To the basin of the Baltic belong Ladoga, the largest lake in Europe; Onega, Peipus, and Ilmen. Finland, too, which toward its south extremity is a mere network of lakes, sends all its waters to the Baltic. Almost all the other lakes of any size belong to the basin of the Volga; chief of these are the Bielo-Ozero, in the government of Novgorod, and the Koubinsköe, in the government of Vologda. In the south are several large salt lakes, among them the Elton and the Khaki Salt Marsh, in the government of Astrakhan.

Geology.—A vast tract of gneiss and other crystalline schists, penetrated by granite, extends west from the Gulf of Bothnia, and north from the Gulf of Finland over the whole principality of the latter name, the western part of the government of Olonets, and the extensive part of the government of Archangel which is isolated from its main body by the White Sea. The only other region where a similar development occurs is in the south, where a large granitic steppe stretches in a southeast direction. It commences near Ovrutch, in the northeast of the government of Volhynia, covers the far greater part of the government of Kiev, as much of the government of Podolsk as lies north of the Bug, the northern half of the government of Kherson, the west and south of Ekaterinoslav, and a part

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of Taurida, and terminates just before reaching the shores of the Sea of Azov, from which it is excluded by a narrow belt of Tertiary marls and limestone. In the east, however, and along the whole crest of the Ural Mountains, from their commencement on the shores of the Arctic Ocean, and almost continuously southward to their last ramifications, granite of more recent origin than that already mentioned occurs, in connection with other eruptive rocks of greenstone, porphyry, syenite, serpentine, etc. These rocks are overlain on both sides of the chain by metamorphic schists, forming long and narrow belts nearly parallel with its principal axis. Immediately to the west appears a similar belt of Silurian strata, which, where lowest in the series, are in the state of chloritic and talcose schists. The only other locality where the Silurian system receives a marked development is on the southern shores of the Gulf of Finland, where it stretches from its western extremity east along the governments of Esthonia and Saint Petersburg, and is then continued across the isthmus between the eastern extremity of the gulf and Lake Ladoga, and along the southern and southeastern shores of that lake. In immediate contact with this Silurian formation on the south, but on a much more magnificent scale of development, appears the Devonian system, or Old Red Sandstone. The main body of this formation commences near the southeastern shores of the Baltic, and gradually widens out with its northeastern and southeastern sides, so as to assume the shape of a wedge. It then forms a wide fork, sending one of its branches northeast across Lake Onega, and along Archangel Bay to the northwestern extremity of Mezen Bay, and the other southeast to the northwestern frontiers of Voronezh. It thus covers continuously the whole of the governments of Kurland, Livonia, Vitebsk, and Pskof, and parts of Vilna, Minsk, Mohilef, and Smolensk, on the one side, and of Petersburg and Novgorod on the other; while its northeast branch traverses Olonets, and penetrates into Archangel; and its southeast branch stretches over considerable parts of Kaluga, Orel, and Tula. The only other localities in which the same formation occurs is as a belt stretching south-southeast from the eastern coast of the Gulf of Tcheskaia in the Arctic Ocean, and in a longer but narrower belt on the western side of the Ural chain, where it immediately overlies the Silurian formation already mentioned. The formation next in order is the Carboniferous. The main body of it lies within the above fork of the Old Red Sandstone, and in immediate contact with it, and then keeping parallel with the northeast branch of the fork, is continued in the same direction to its termination in Mezen Bay. It occupies the whole of the government of Tver, the capital of which is situated near its centre; and large parts of Smolensk, Kaluga, Tula, and Riazan on the one side, and of Novgorod and Olonets on the other. The government of Moscow is situated in the very heart of it, and that of Vladimir on its eastern side. It is evidently continued beneath these governments, and covers part of their surface, the other and far greater part being covered by oolite or Jura limestone. The Carboniferous system occurs in other two distant and isolated localities; the one in the south, a little north of the Sea of Azov, where

it occupies the eastern part of the government of Ekaterinoslav, and the western extremity of that of Don Cossacks, and where, too, the coal forming the characteristic mineral of the system is partially worked by pits; the other locality is on the western side of the Ural chain, where, in the ascending series, it succeeds the Silurian and Devonian systems, and has a larger development than either of them. This development of the Carboniferous system on the side of the Ural chain, and the still larger development above described as existing in the governments of Smolensk, Kaluga, etc., form the opposite boundaries of a system which in European Russia is highly developed; and to which from the large space which it covers in Perm and the contiguous governments, the name of the Permian system has been given. Its rocks belong to the upper part of the coal measures, and consist chiefly of magnesian limestone and new red sandstone. The latter name is still often applied to the whole system. The Permian system extends over the governments of Kostroma, Viatka, and Kazan, and large parts of Archangel, Vologda, Yaroslavl, Nijni-Novgorod, Simbirsk, Orenburg, and Perm. In the north of the governments of Kostroma and Viatka, and more especially in the part of Vologda between the towns of Nikolsk and Ust-Sisolsk, it disappears for a time beneath strata belonging to the Jurassic or oolitic system. This system is developed partially in several other localities, and very largely in the northeast of the government of Archangel. Immediately above it in the geological series is the Cretaceous system, of which the principal localities are Chernigov, Orel, Kursk, Kharkov, and Voronezh, near the centre; Volhynia and a small part of Poland in the west; and a long tract along the northern base of the Caucasus. The rocks next in succession belong to the Tertiary formation, which in both its Eocene and Miocene periods is very largely developed. Strata of the Eocene period, commencing in the east in the government of Simbirsk, stretch west over the greater part of the governments of Penza and Tambov, then, after a considerable interruption, reappear on the frontiers of Kursk and Kharkov, cover the far greater part of the governments of Chernigov and Poltava, and are thence continued without interruption into the governments of Mohilev, Minsk, Grodno, and finally into Poland. The Miocene period has its chief developments in Volhynia, Podolsk, and Bessarabia. Beds of still more recent formation may be traced in the limestones, marls, and clays on the northwestern shores of the Black Sea, on the far greater part of the Peninsula of the Crimea, on the eastern and northern shores of the Sea of Azov, on the low flats along the western and northern shores of the Caspian, and the low, sandy steppes of Astrakhan. Mere alluvial deposits, of comparatively recent date, are to be found in a greater or less degree at the mouths of all the rivers, and are particularly discernible in the great estuary of the Pechora. Vast numbers of erratic blocks and similar drift are spread over the greater part of Northern Russia, evidently transported from Finland, Lapland, and Sweden.

Minerals.—These are numerous and valuable. Gold is obtained in large quantities, both by mining and washing, on the slopes of the

Ural Mountains. The richer deposits, however, with a few exceptions, are found on the east side of the chain, and therefore belong more properly to Asiatic than to European Russia. Gold has also been found in the northwest of Russian Lapland. Copper is found both in the Valdai and the Ural Mountains. To the west of the latter, in all the low country of Perm, are vast cupriferous deposits, from which large quantities of metal are annually obtained under the most favorable circumstances, the workings themselves being not only comparatively easy, but all the materials necessary for smelting existing in their immediate vicinity. The governments of Olonets, Viatka, Kazan, Vologda, and Orenburg have also their copper mines. Iron, the most widely diffused of all the Russian metals, is found not only among the mountains, but in the lowest marshy grounds of Finland and the northern governments, where extensive beds of bog iron ore have been formed. The principal seat of the iron manufacture is in the government of Perm, but important workings are carried on, and great numbers of blast-furnaces have been erected, in many other quarters. Near Zlatoust, to the west of the Urals, there are important limonite deposits; but east of the Urals, at Nijni Tagilsk, magnetite is worked. Lead is more sparingly diffused, and is worked chiefly in the Ural chain and some parts of Poland, particularly the vicinity of Cracow and Sandomir. It sometimes contains such a percentage of silver as to make it worth extracting. Platinum has long been worked in the Ural chain, in the most productive mines of that metal which are known to exist in the world. Zinc is worked in Poland, in the government of Piotrkov, and quicksilver is mined in the south, in the government of Ekaterinoslav. The latter government also yields a considerable amount of manganese. Salt is found in inexhaustible abundance, both in brine pits and mines. In almost every part of the vast extent of surface already described as belonging geologically to the Permian system it may easily be found, and in numerous localities is extensively and profitably worked. It is also very abundant in the southeastern steppes. Saltpeter is found chiefly in the government of Astrakhan. From the vast extent of country which has been shown to be occupied by the Carboniferous system it may be reasonably concluded that many extensive coal fields must exist. It would seem, however, that Russia in this respect bears a considerable resemblance to Ireland, where the large developments of the Carboniferous system are chiefly confined to its lower strata, and is much more remarkable for its immense masses of mountain-limestone than its productive seams of coal. The most important and most productive coal basin is that situated north of the Sea of Azov, and traversed by the river Donetz. It has an area of over 10,000 square miles, and yields bituminous coal in the west and anthracite in the south. Its production has greatly increased in recent years. Rostov and Mariupol are the ports of this region. Another valuable coal basin is that of Dombrovo, in southwestern Poland, and there is a less productive one in the south of the government of Moscow. The coal district to the west of the Urals is traversed by a line of railway. In the centre of the beet-root sugar producing country, about Kiev and Elizabethgrad,

is another vein of coal. With the increase and improvement of railway communication the output of coal has shown a marked increase. For 1868 the output for Russia (Poland excepted) was only 147,500 tons; in 1872 it reached 530,000 tons; and in 1899 it had increased to 13,705,000 tons. The chief obstacle to a more general use of coal throughout the empire is the expensiveness of transport by rail, which frequently even surpasses the price of the coal. For the smelting of metals the boundless forests furnish a more valuable and convenient material; and many years must elapse before these can be so much thinned as to make either the search for coal or the working of its objects of paramount importance. Naphtha springs are found in the province of Archangel, in that of Samara and elsewhere, but the better known and richer naphtha or petroleum springs are situated to the north and south of the Caucasus range, especially in the country around Baku. In this region there are immense underground stores of the valuable fluid, and the petroleum industry has developed enormously in recent years, so that since 1898 the output of Russian petroleum has exceeded that of the United States. In 1891 the United States produced 62 per cent, Russia 38 per cent of the total, while in 1901 the United States produced 38 per cent, and Russia 62 per cent, the situations being exactly reversed in ten years. The only other mineral products deserving of notice are quarries of granite and marble, both of which of excellent quality, are found near the shores and to the northeast of Lake Ladoga; and kaolin, which is worked in the governments of Kherson and Chernigov.

Climate.—As the country extends over 35 degrees of latitude, from the warmer regions of the temperate far into the regions of the frozen zone, it exhibits several marked diversities of climate, usually considered in four divisions—a polar region, including all the country north of latitude 67°; a cold region, extending from latitude 67° to 57° N.; a temperate region, from latitude 57° to 50° N.; and a warm region, from latitude 50° to 37° N. The characteristic features of the climate in general are a greater coldness and variability than is common under the same latitudes in the more westerly parts of Europe. The mean annual temperature of the upper part of the Norwegian coast to its extremity at the North Cape is above the freezing point, whereas a considerable portion of Russia within the same, and even in a lower latitude, is below it. This is true of the whole of Russian Lapland as far south as 66°; and to the east of the White Sea the thermal line, indicating a mean annual temperature of freezing, descends so rapidly that on reaching the Ural Mountains it is found to be as low as 60°. The region to which the name of cold has been given has a mean annual temperature varying between 32° and 40°, but very unequally divided throughout the year, the cold in winter often sinking the thermometer to 30° below zero, or 62° below freezing, while the summer heat often raises it above 80°. At Saint Petersburg, considerably below the centre of this region, the mean annual temperature is rather above 40°; on the other hand, that of Kazan, situated at the very south extremity of the region, but much farther inland, is rather

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below 36°. The temperate region, situated between lat. 57° and 50° N., has a mean annual temperature varying from 40° to 50°, and includes within it the far finest part of the Russian territory, though even there the thermometer has a very wide range, the summer heat, which suffices to grow melons and similar fruits in the open field, being often succeeded by very rigorous winters. The warm region, extending from 50° southward, well merits the name from its extreme summer heats, the thermometer in June and July standing commonly about 100°, and often considerably higher. It is not, however, free from the remarkable contrasts which a Russian summer and a Russian winter exhibit; for the Sea of Azov, situated almost in the heart of this region, usually freezes about the beginning of November, and is seldom open again before the beginning of April. In all the countries bordering on the shores of the Baltic Sea and the Arctic Ocean, and bounded on the west and north by the basin of the Volga, the air is charged with a superabundance of moisture, which descends in mists and frequent falls of rain or snow. Toward the centre, and still farther east, the superabundance of moisture disappears, though enough still remains to keep vegetation in full vigor even at the hottest season. Still farther south the want of rain is often felt, and long-continued droughts do frequent mischief. In general, however, the climates of all the regions are not unfavorable to health.

Forestry and Flora.—Forests are found chiefly in the more northern governments, particularly Archangel, Vologda, and Perm, and cover about 39 per cent of the total area of European Russia. In many of the central and southern governments a deficiency of timber is seriously felt, and many extraordinary expedients are resorted to in order to obtain adequate supplies of fuel. The governments most imperfectly provided with wood are Esthonia, Bessarabia, Kherson, Ekaterinoslav, and Astrakhan. The prevailing trees of the northern forests are fir, larch, alder, and birch. The oak is seldom found beyond lat. 61°. A considerable proportion of the surface still continues almost in a state of nature; and, where it is well wooded, it is a question whether any other mode of occupation would be equally productive. Russia possesses a vast number of phanerogamous plants, but the examination which botanists have made is incomplete and it is probable that many remain to be discovered.

Fauna.—Animals, both domestic and wild, are numerous in Russia. Among the latter are the bear, the wolf, wild hog, the desman, the mole-rat, the saiga, the bobak or Russian marmot, the elk, the bison, the lynx, and various animals which are hunted for their furs. Wild fowl abound, particularly near the mouths of rivers; among them the pelican frequents the shores of the Black Sea. Both on the coasts and in the rivers a great number of productive fisheries are carried on. In the Arctic Ocean whales are killed, and vast numbers of seals are taken. The rivers of the Caspian, particularly the Ural and Volga, and the Sea of Azov, are celebrated for their sturgeon. In the same quarters are also important salmon fisheries.

Land Tenure.—The political divisions of the Russian people comprise numerous grades of no-

bility, which are partly hereditary and partly acquired by military and civil service, especially the former, military rank being most highly prized in Russia. The clergy, both regular and secular, form a separate privileged order. The higher clergy were formerly possessed of great wealth, but much of their property was confiscated by Catharine II., who compensated them by state pensions. Previous to the year 1861 the mass of the people were serfs subject to the proprietors of the soil. The Emperors Alexander I. and Nicholas took the same initial steps toward the emancipation of this class; but a bold and complete scheme of emancipation was begun and carried out by Alexander II. The decree of emancipation was dated 3 March 1861, and began to come into execution within two years. There were about 22,000,000 of serfs belonging to private proprietors, and rather more than that number on the crown lands. By an imperial decree of 8 July 1863, lands were granted to the peasants on all the estates of the crown on a 49 years' rental equal to the former poll-tax, and as a freehold estate at the expiration of this period. A similar arrangement was made on behalf of the peasants on the lands of private proprietors. The redemption money of the serfs with their land was estimated at 16½ years' purchase of their annual produce. Twenty per cent of this had to be paid by the serfs on procuring their emancipation, the remaining 80 per cent is guaranteed by the government, which levies it from the peasantry in a tax extending over 49 years. The emancipation of all the serfs on these terms was arranged for by July 1865, and from that date this form of servitude has ceased to exist in Russia. Since this change the cultivable land in Russia is mainly distributed among three classes. The crown holds nearly 35 per cent, the emancipated peasants about 20, while the remainder, with the exception of mines and town lands, is in the hands of the nobility and other landed proprietors.

Agriculture.—Russia is decidedly an agricultural country. Its progress in the science of agriculture has been slow, and the amount of produce obtained is due more to the natural fertility of the soil than to any ability displayed in extracting it; there being perhaps no country in Europe in which so much grain is obtained at so small an expense of skill and labor. In Livonia, however, and the Baltic provinces generally, and in some of the more celebrated wheat districts of the Ukraine, an improved husbandry has been introduced, and government, by the appointment of agricultural chairs in the universities, and the formation of model farms, is laudably endeavoring to extend the movement to other quarters. After deducting all the regions where the rigors of the climate, without making the growth and ripening of grain absolutely impossible, are incompatible with its culture as a regular branch of industry, vast tracts of land remain, where the soil is almost of inexhaustible fertility, and all the cereals are produced in such abundance as not only to meet the home consumption but leave a large surplus for export. The most important crops raised for food are rye, wheat, barley, oats, buckwheat, maize, and potatoes; and for other purposes, hemp, flax, hops, tobacco, and beet-root for sugar. The principal wheat districts are part

of Poland, particularly the governments of Warsaw, Radom, and Lublin; the fertile alluvial tracts along the banks of northern rivers; and the governments of Volhynia, Podolsk, Kiev, and Poltava. Rye, from its natural adaptation to the soil, and its almost universal use as an article of food, is cultivated in every quarter up to lat. 65°. Barley ripens in lat. 67°, but is in far less general repute than rye. Oats are extensively grown in several governments, and more especially in the rich alluvial tracts of Archangel, where the peasants, after satisfying their own wants, grind the surplus into meal, and export it in considerable quantities to the coast of Norway. Maize forms one of the most important crops of Bessarabia, where a return of sixty-fold is said not to be uncommon. Potatoes are largely grown in Saratov, in Poland, and in the districts which border the Baltic; in the last partly for food, but much more for the supply of numerous distilleries, which are employed in converting them into brandy. Both hemp and flax are staple products. The former is grown to an immense extent in all the governments which border on the Ural chain, and on both sides of the upper course of the Volga, particularly in the governments of Tver, Yaroslavl, and Kostroma. Flax is also cultivated to a great extent in the same districts, but more especially in the governments of Olonets, Vologda, Livonia, and the southern parts of Finland. Both their fibre and their seed form most important articles of export from the ports of Riga, Saint Petersburg, and Archangel. Kitchen gardens, in many parts, attract considerable attention, and cabbages, turnips, carrots, and onions are occasionally cultivated on an extensive scale; in some of the districts bordering on the southern steppes the watermelon thrives amazingly, attaining immense size with little culture, and, while in season, forms a principal food of the lower classes. In Astrakhan, on the banks of the Volga, licorice grows with a luxuriance unknown elsewhere, and furnishes juice sufficient to form an important article of export. Few fruit trees are found beyond latitude 56° and their regular culture cannot be profitably carried on beyond latitude 53° N. There apples, pears, and plums become tolerably abundant; and farther south peaches, apricots, quinces, almonds, and pomegranates become common fruits. The vine and mulberry also are extensively cultivated, and considerable quantities both of wine and silk are obtained. In the Crimea extensive vineyards have been formed with plants selected with the utmost care, and several of the wines have already acquired a high name. Other governments have imitated the example, and the export of wine promises to become an object of great national importance. Among the principal districts in which the culture of the vine is regarded as an object of primary importance may be mentioned Bessarabia, Kherson, Kiev, Astrakhan, and the Don Cossacks. The last makes large quantities of a wine resembling champagne, which finds a ready sale in Saint Petersburg, Moscow, and many of the larger towns.

Stock-raising.—Horses of various breeds are raised, of which those in the north are generally small, but hardy; those of the central and south provinces large and well adapted for draft; and those of the Cossacks remarkable

for their spirit and endurance of fatigue, and their admirable adaptation for light cavalry. On several of the steppes horses still run wild. Cattle are much used, particularly in the south, for agricultural operations, and exist in such numbers that tallow and hides form very important articles of export. The best breeds are those of the Ukraine, Archangel, Bessarabia, and Grodno. In Livonia a great number of excellent cows are kept for the dairy, and much good cheese is made. The sheep are chiefly of three breeds—the original Russian, which is found in vast numbers in every part of the country, and though generally inferior, and producing a very indifferent wool, has been greatly improved by crossing with the merino and Saxon; the Kirghiz breed, remarkable for large size, a darkish-red color, long, but coarse wool, and more especially for their ponderous tails, from which from 30 pounds to 40 pounds of tallow are obtained, and existing in vast numbers on the steppes of the Volga; and the Circassian breed, not confined to the Caucasian provinces, but widely diffused in the Crimea, and among the Cossacks of the Black Sea and of the Don. The improved breeds of sheep are found especially in the Baltic governments of Livonia, Esthonia, and Kurland, but are rapidly spreading into other quarters. Goats are numerous in the south, where they are valued chiefly for their skins, which are used in making morocco leather. In some districts Angora goats are kept for their fleeces, which are remarkably fine, and manufactured into shawls. In the northern regions, bordering on the Arctic Ocean, large herds of reindeer are kept; and in the south, at the opposite extremity, among the Tartars of the Crimea and the inhabitants of the Caucasus, the camel is often seen.

Commerce.—Russian commerce is now very extensive. The chief trade is with Great Britain and Germany. Above a fifth of the exports go to the former, and the latter supplies about 40 per cent of the imports. The principal exports are timber, oats, flax, and tow, wheat, barley, eggs, and linseed. Raw cotton for manufacture is imported annually to the value of from \$30,000,000 to \$50,000,000. Wool and silk are also imported, as well as coal, machinery, iron, copper, lead, and ships. Besides Great Britain and Germany, a considerable trade is carried on with the United States, France, Austria-Hungary, Sweden and Norway, Egypt, Belgium, Italy, Turkey, and Denmark, as well as with China, Persia, and other eastern countries in tea, silk, etc., in exchange for furs, leather, and fabrics of European manufacture. The values of the general exports and imports (exclusive of specie) of European Russia for five recent years were:

YEARS	Exports	Imports
1896	\$413,180,000	\$351,318,000
1897	435,972,000	316,000,000
1898	439,602,000	370,476,000
1899	376,188,000	390,288,000
1900	429,852,000	375,822,000

Manufactures.—In a country where so much land remains to be taken into cultivation, and population is very much scattered, manufactures cannot be expected to be carried on upon an extensive scale, except in a few leading towns. Considering the unfavorable circumstances the

progress of Russia in manufactures is much greater than could have been anticipated, and certainly much greater than it could have been had not the government done the utmost to promote it, both by the establishment of large model manufactories and various other modes of encouragement. The branches in which most progress has been made are leather, both ordinary and morocco, the latter particularly at Astrakhan, Torjok in the government of Tver, Kazan, and Taurida, in all of which the article produced is unsurpassed in any other country in Europe; cotton twist and cotton goods at Saint Petersburg, Moscow, and in the governments of Vladimir, Kostroma, and Piotrkov; woolen and linen goods in many parts of Poland, the governments of Kiev, Ekaterinoslav, Moscow, Kaluga, and most of the principal towns; silks, particularly in Saint Petersburg and Moscow; sail-cloth, at these two capitals, and also in the governments of Archangel, Riazan, and Novgorod; fine cashmere shawls, in the governments of Penza and Ekaterinoslav; fine carpets, at Kamenskoi, Smolensk, and Kursk; cordage at Archangel and in the government of Orel; metals, more especially iron and copper, in the government of Perm, and many other localities; firearms and cutlery, in the governments of Tula, Nijni-Novgorod, and Vladimir; swords and edged weapons near Zlato-ust, in the government of Ufa; plate-glass and crystal, at Saint Petersburg, Tula, Tver, and in the Donetz basin; paper, at Moscow, Saint Petersburg, Yaroslavl, Kaluga, and in Livonia; hosiery, at Sarepta and various other places; and oil, candles, soap, glue, tobacco, window glass, glass bottles, etc., in almost every important town. The total number of persons employed in manufactories, mines and other establishments as recently given was about 2,100,000, the yearly production being valued at \$925,000,000.

Shipping and Navigation.—The mercantile marine of Russia on 1 Jan. 1901 consisted of 3,038 vessels with an aggregate of 633,819 tons; this included 745 steamers of 364,360 tons, 715 sailing vessels aggregating 91,270 tons, and 126 steamers of 49,258 tons belonged to the Baltic; 416 sailing vessels of 24,100 tons, and 42 steamers of 8,396 tons belonged to the White Sea; 635 sailing vessels of 42,843 tons and 316 steamers of 186,774 tons belonged to the Black Sea and the Sea of Azov; while 527 sailing vessels of 111,246 tons and 261 steamers of 119,932 tons belonged to the Caspian Sea. In 1901, 1,109 Russian vessels of 727,000 tons aggregate and 3,987 foreign vessels of 3,049,000 tons aggregate, entered the ports of European Russia; and 1,349 Russian vessels aggregating 713,000 tons and 7,441 foreign vessels aggregating 6,823,000 tons cleared the same ports.

Canals and Railways.—Considering the vast extent of country, the seaports are numerous, being Archangel, in the Arctic Ocean; Saint Petersburg, Reval, Helsingfors, Libau, Riga in the Baltic; Odessa, Nicolaiev, Sebastopol, Theodosia, Batoum, Poti, Kertch, Mariopol, and some minor ones in the Black Sea; Taganrog and Rostov in the Sea of Azov; and Astrakhan, Baku, Petrovsk, Derbent, Krasnovodsk, Usun Ada in the Caspian. The great distances at which the seas containing these ports are situated from each other

and from the interior of the country must have confined the foreign trade within very narrow limits had not a remarkable number of internal feeders been provided, partly by nature and partly by art; by nature, in the magnificent streams which wind across the country in all directions, and owing to the general flatness of the surface are well adapted for navigation; and by art, first in the great system of canals by which the different basins to which these rivers belong have been made to communicate with each other, so as to give a continuous navigation from the Arctic Ocean to the Black Sea, and from the Baltic to the Caspian; together with a network of branch canals, by which all the great towns of the interior have ready access to their outports and to each other; and secondly in the system of railways, by which internal commerce will eventually be more thoroughly opened up. The railway system was begun by the Emperor Nicholas, and has been carried out more fully and comprehensively under his successors. Some of the lines are formed directly by the state, others by private companies under guarantees from government. The greatest railway undertaking in the empire is the Trans-Siberian line, now practically completed, from Chelyabinsk to Vladivostok and Port Arthur. The total length of railways open for traffic in the end of 1901 (including Asiatic Russia) was 36,526 miles, of which about 23,400 miles were state railways. European Russia had 27,500 miles of railway. Among the most important lines in operation are that which unites Saint Petersburg and Moscow with Warsaw, and through it with the railway system of Europe; the lines from Moscow to Nijni-Novgorod and Riazan, from Orel to Vitebsk, Voronezh to Rostov on Don, Dunaberg to Vitebsk, Kursk to Kiev and to Kharkov, Kharkov to Azov, and the line from Odessa to the interior.

Moneys, Weights and Measures.—The present currency system of Russia was fixed by laws passed in 1885 and 1897. The unit of account, represented by a silver coin, is the ruble of 100 kopecks, valued at 51.5 cents. There are three gold coins, the imperial (15 rubles and 10 rubles), 7.50 and 5 rubles. Besides the ruble the following are coined in silver: half-ruble or poltinnick (50 kopecks), quarter-ruble, and pieces of 20, 15, 10, and 5 kopecks. The copper coins are 5, 3, 2, 1, $\frac{1}{2}$, and $\frac{1}{4}$ kopeck. The law of 1897 fixed the currency on a gold basis. The ruble as the fifteenth part of the gold imperial is the unit in all payments and business transactions. The circulation of the silver pieces representing 1, $\frac{1}{2}$, and $\frac{1}{4}$ ruble is limited by a ukase of 1898 to three rubles per head of the population, and in ordinary transactions these coins are legal tender up to 25 rubles only. Notes of the value of 1, 3, 5, 10, 25, 50, 100 and 500 rubles are issued by the State Bank. By a ukase of 1897 the issue of paper money was restricted. Up to six hundred million rubles, the bank must secure its issue of notes by a gold reserve representing half the issue, and beyond that amount the gold reserve must be equal to the issue, ruble for ruble. Since 1877 the monetary unit of Finland has been the mark, equal to a franc. The coins in-

clude 20-mark and 10-mark gold pieces; 2-mark, 1-mark, $\frac{1}{2}$ -mark, and $\frac{1}{4}$ -mark silver pieces; and three smaller bronze pieces. One mark is equal to 100 penniä (singular, penni). Silver is a legal tender only up to ten marks. The Russian unit of length is the foot, equal to the British foot, and like it divided into 12 inches. Higher units are the arshin, equal to 28 inches; the sajene, equal to seven feet; and the verst, equal to 500 sajenes or 3,500 feet. A dessiatine is equal to 2,400 square sajenes, or nearly 2.7 acres. The standard of capacity for liquids is the shtof, equal to 2.7069 pints or 93.82 cubic inches. A vedro is equal to 10 shtofs. The unit of capacity for dry goods is the chetwert, equal to 5.774835 gallons. The pound, or unit of weight, is slightly greater than nine tenths of a pound avoirdupois. Forty pounds are equal to one pood. In 1886 the metric system of weights and measures was introduced into Finland.

Banking.—The continual fluctuations in the value of the paper ruble, and the troubles therewith, were ended in 1895 by the Ministry of Finance introducing a regular value for the paper currency, and by the law of 29 Aug. 1897, authorizing the issue of paper currency under certain conditions by the State Bank. (See MONEY, WEIGHTS, AND MEASURES.) The Bank of Russia acts in the double capacity of state bank and of a commercial bank, and has 113 branches throughout the empire. On 1 Jan. 1903 its assets were approximately \$907,516,000; its liabilities including a capital and reserve of \$27,500,000, were \$907,776,500. In 1902 there were 5,629 state, municipal, and postal savings banks with 3,935,773 depositors, and deposits amounting approximately to \$361,491,000. There were also 241 municipal banks, 133 societies of mutual credit, 42 banking companies, and 47 mortgage banks, the latter including state banks for mortgage loans to the nobility, and land banks for the purchase of land by the peasants.

Government.—The emperor (the *czar* or *tsar*) is an absolute ruler having entire control of the legislative, executive, and judicial functions of government, and being irresponsible for their exercise. Since the time of Peter I. the czar has been head of the church. The title czar was borne by the emperors until the time of Alexander II., who with his successors prefer to adopt the title of emperor. By a decree of Peter I. in 1722 the sovereign was authorized to elect his successor, without regard to the law of primogeniture. This was altered by Paul I., who in 1797 fixed the succession according to the law of primogeniture, with preference to the male line. Alexander I. recognized the duty of the emperor to govern according to law, and the right of the senate to remonstrate. It is a fundamental law of the realm, established by Peter I., that the sovereign and the royal family must be members of the orthodox Greek Church. By a decree of Alexander I. the issue of any member of the royal family marrying without the consent of the emperor forfeit the right of succession.

The administration is conducted under the control of the private cabinet of the empire by four great councils. The council of the empire, established on its present organization by Alex-

ander I. in 1810, consists of the *officio*, the princes of the imperial household, an unlimited number of members appointed by the emperor. It meets collectively and is also divided for administrative purposes into four sections, each of which has a separate president. The sections preside over the departments of legislative, judicial, and church administration, finance, and the interior.

The senate, established by Peter I. in 1711, is the high court of justice of the empire and controls all the legal tribunals. It is divided into six sections, which administer justice in different provinces. All the sections sit in Saint Petersburg. The senate consists of 100 members, not exclusively of the legal profession. Each section is presided over by a senator. The senate signs its decrees as the representative of the emperor. The minister of justice presides over the meetings of the whole senate. The senate has the power to audit public accounts, to appoint and dismiss numerous offices, and the right to propose and elect the emperor.

The Holy Synod, established by Peter I. in 1721, superintends the religious affairs of the empire. It comprises the metropolitans of Saint Petersburg, Moscow, and Kiev (patriarchs of Georgia and of Poland), and 10 archbishops sitting in turn.

The committee of ministers is composed of 11 members, each presiding over a department. The principal minister and member of the committee who are assisted in the department by subordinates. The various ministries are: the imperial house, foreign affairs, war, interior, public instruction, finance, justice, culture, public works, general conscription, and the nobility.

There are also imperial cabinets for charitable affairs, public instruction, girls, petitions, and one dealing with the economy, mines, manufactures and agriculture. Yielding to the popular demand for reform, Nicholas II., 19 Aug. 1905, issued a manifesto granting a National Duma or Assembly (*Gosoudarstvennaya Duma*) representatives from the whole empire to take an active part in the elaboration and discussion of measures for the improvement of the empire. See *History*.

Finance.—The chief sources of revenue are direct taxes, indirect taxes (customs, telegraphs, mines, spirit monopoly, forests, and the principal items of revenue are those represented by administration of debt, army, navy, pensions, and railways). The total estimated revenue for 1902 was \$1,000,392,240 of which \$900,392,240 represented ordinary revenue. The total expenditure was \$1,087,956,740 of ordinary expenditure. Ordinary revenue thus exceeded the ordinary expenditure by about \$12,500,000. The debt on 1 Jan. 1901 amounted to \$1,100,000,000, much of it representing railway construction. The debt charge included in the estimate for 1902 amounted to \$143,230,000. The expenditure of Finland in 1902 amounted to \$21,336,725, and the debt was almost all contracted since 1889.

Army.—The Russian army is recruited mainly by conscription, and its organization has been determined by laws passed in 1888, and 1893. All able-bodied men

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to military service from the age of 21 completed to the age of 43 completed, with the exception of doctors and teachers (in time of peace) and of the Christian clergy. The period of service comprises 18 years in the active army, of which four (five for the cavalry, horse-artillery, engineers, and some others) are passed with the colors, the rest in the reserve, while during the remaining four years required to complete his forty-third year the soldier belongs to the first section of the territorial army, which includes also those not drawn for active service during the whole 22 years of their liability. The second section of the territorial army includes all those drawn for service but not incorporated, for some reason, in the permanent army. The Cossack army is organized differently, and liability to service begins on the completion of the 18th year. The period of service is diminished in the case of those who possess certain educational qualifications. There are 25 army corps, namely, the guards (Saint Petersburg), the grenadiers (Moscow), 21 territorial corps having their respective headquarters at Saint Petersburg, Grodno, Vilna, Minsk, Warsaw (3), Simferopol, Odessa, Kiev (2), Kharkov, Kovno, Vinniza, Smolensk, Lublin, Vitebsk, Moscow, Dorpat, Brest-Litovski, and Riga, and the first and second corps of the Caucasus, with headquarters at Alexandropol and Tiflis respectively. Most of these corps are formed of two divisions of infantry, two brigades of field-artillery, one division of cavalry, and one section (two battalions) of horse-artillery, but the guards and the grenadiers have three divisions of infantry and three brigades of artillery, and the guards corps has two cavalry divisions and one brigade of horse-artillery, while the numbered corps also present some irregularities. There are also two cavalry corps, with two divisions each, having their headquarters at Warsaw. The total strength of the European army organized in the corps formations is therefore 52 divisions of infantry, 22 divisions and two brigades of cavalry, 52 brigades of field-artillery, and one brigade of horse-artillery. In time of war an army corps consists of two infantry divisions (each 18,000 men) and one cavalry division (4,000 men), comprising altogether 40,000 men. Each infantry division in war includes cavalry, artillery, etc., and each cavalry division includes artillery. The strength of a battalion is about 500 in peace and about 1,000 in war. The following table shows the approximate effective war strength of the Russian army in 1900:—

	Infantry	Cavalry	Artillery	Engineers	Train
Field Troops...	1,019,500	123,800	122,500	47,100	26,400
Reserve Troops...	691,500	99,300	46,670	10,300	.....
Fortress Troops...	162,600	.....	81,500	12,400	.....
Reinforcements...	285,000	48,900	38,600	7,840	.....
National Defense	695,600	22,350	28,450	4,100	.....
Others.....	41,000	.....	.....	.....	.....
Total.....	2,895,200	294,350	317,720	81,740	26,400

The grand total of all arms is 3,615,410, of whom 66,410 are officers. The fortresses of Russia are Alexandropol, Batum, Brest-Litovski, Cronstadt, Dvinsk, Dünamunde, Ivangorod, Kars, Kertch, Kiev, Kovno, Libau, Novogeorgievsk, Odessa, Ossovietz, Ochakov, Poti, Saint Peters-

burg, Segri, Sevastopol, Sveaborg, Warsaw, Vladivostok, and Viborg.

Navy.—In 1901 the strength of the Russian navy was as follows, vessels in course of construction being included:— Battleships, 24 (7 first-class, 15 second, 2 third); coast-defense vessels, 9 (4 modern); armored cruisers, 3; first-class cruisers, 2; other cruisers (protected or belted), 16; torpedo gunboats, etc., 9; destroyers, 30; first-class torpedo boats, 43; other torpedo boats, 150; submarines, 1; and steam-yachts, training-ships, etc. The total personnel of the Russian navy is about 46,000.

Ethnology.—Ethnologically the peoples of Russia are comprised under two of the great divisions of the human race—the Caucasian and the Mongolian; but under each a considerable number of varieties are traced. The Mongolian stock in European Russia is represented by the Finns and their allies, and by the Kalmucks, who occupy some of the southeastern steppes, but have lost many of their distinctive features by intermarriage with Caucasians. Of the Caucasian stock the Slavonians, under the names of Russians, Poles, Lithuanians and Letts, Wallachians and Servians, form about nine tenths. Of these again, the Russians proper form the great body of the population, and are estimated at about 50,000,000. They occupy, with little intermixture, the central provinces between the Dnieper and Volga; form a vast majority in the north, between the Ural Mountains and the White Sea, and, in the south, between the Don and the Dniester; and are found, more or less intermingled with other varieties, in all other parts of the country. The Poles are found in the greatest number in their own country. In that part of it which in the dismemberment fell to the share of Russia they amount to about 9,000,000. The Lithuanians are found chiefly in northern Poland, and in the governments of Vilna and Minsk. They are estimated at about 1,500,000. Still farther north are the Letts, or as they are often called, the Kurs, from living chiefly in Courland. They are also the chief occupants of Livonia, are wholly devoted to agricultural pursuits, and may amount to 500,000. The Wallachians, and among them a few Servians, are found only in Bessarabia, between the Dniester and Pruth. Their language is a descendant of Latin mixed with foreign words. They, too, do not exceed 500,000. The Tchudes, or Finns, though they belong to the Mongolian race, have little or none of the characteristic Mongolian type of countenance. They are of middle size, fair complexion, and generally have light hair and blue eyes. They are settled on both sides of the Gulf of Finland, but on the north of the gulf form the two marked divisions of Finns proper and Laplanders, the former living south and the latter north of lat. 65°. To the south of the gulf the Finns occupy the far greater part of Esthonia and a small part of Livonia. Widely separated from the western Finns, though the mode of separation is not known, a great number of Tchudic or Finnish tribes are found occupying the western slopes of the Ural Mountains and the banks of the Middle Volga under the names of Syrians, Permians, Voguls, Votiaks, Tchuvassees, Tchermisseees, Mordwins, and Teptiares. The most numerous are the Tchuvassees and Tchermisseees, who live together on both sides of the Volga,



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in the neighborhood of Kazan, and are estimated at about 500,000. All the others do not exceed the same number. The second great branch of Mongolians inhabiting Russia are the Tartars, who here form four distinct tribes—the Tartars of Kazan, in some respects the most civilized nation in Russia, though the great majority of them still cling to Mohammedanism, and numbering about 230,000; the Bashkirs, occupying both sides of the Ural Mountains from lat. 56° to 54° N., still given to wandering life, and amounting to about 130,000; the Nogais, occupying a large part of the Crimea and the steppe to the north of it, dispersed over the country east of the Sea of Azov and the northern base of the Caucasus, and amounting in all to about 600,000; the Metcheriaks, forming a few small tribes, not exceeding 20,000 persons, live among the Bashkirs. The German or Teutonic race inhabiting Russia consist chiefly of Germans and Swedes, intermixed with a few Danes. The Germans are dispersed over the Baltic provinces south of the Gulf of Finland, among the Letts and Esthonians, where they constitute the greater part of the nobility. They are also numerous in Saint Petersburg, Moscow, and other mercantile towns and seaports, and a considerable number of German colonists are settled in the government of Saratov and other parts of the Middle Volga. The Swedes are numerous both along the eastern shores of the Gulf of Bothnia and the northern shores of the Gulf of Finland. Their number in these localities, and more particularly in Esthonia, is supposed to exceed 100,000. The Greeks, dispersed over all the southern provinces as merchants, and in the Crimea, where they are the sole occupants of several villages, are estimated at about 500,000. There are also the Jews, who are seldom found in the central and northern provinces, but are very numerous in ancient Poland, particularly in the governments of Vilna, Grodno, Volhynia, and Podolsk, where they form the far greater part of the urban population. Their number is supposed to exceed 2,900,000.

Population.—As given in the table of the official divisions of the empire, the total population according to the census of 1897 was 129,004,514, of which 106,264,136 were resident in European Russia. The average proportion of women to men is 99.8 women to 100 men, although in the Russian provinces and Finland it is respectively 102.8 and 102.2 women to 100 men. The natural annual increase is over 1,700,000.

Education.—About \$20,000,000 per annum are expended by the State on education. Including secondary and primary schools, the number of educational establishments maintained wholly or in part by government amounts, so far as can be ascertained, to about 50,000, the pupils numbering about 2,500,000. The country is divided into educational districts, but the organization of the means of education is as yet little more than adequate for the education of public officials, and the great mass of the population is wholly uneducated. There are universities at Moscow, Saint Petersburg, Kiev, Kharkov, Yuryev, or Dorpat, Warsaw, Kazan, Odessa, and Tomsk. In Finland, which has a separate system, education is nearly universal, and there is a university at Helsingfors.

Religion.—The established religion is that of the Eastern or Greek Church (GREEK CHURCH.) The Russian Church is established independently under the empire and the Metropolitan of Novgorod is the ecclesiastical head. It maintains communion with the patriarchates of Constantinople, Jerusalem, Antioch, and Alexandria, and recognizes the authority of the joint patriarchate of the councils of the whole Eastern matters of doctrine. Religious toleration is said to prevail in Russia, except towards foreigners. The members of the orthodox are not allowed to change their creed, are, however, considerable sects of Greek Churchmen. The Greek Church included, is estimated to number in Russia 75,000,000; the Roman Catholic 2,950,000; Protestants, 2,950,000; Jews, 3,000,000; and medans, 2,600,000.

Judiciary and Local Government.—The parts of the empire are governed by codes, the laws and institutions of Poland being partly respected, the form of a quasi-independent form of government in the provinces are under general government exercise a general control of the administration in the name of the emperor. Zemstvo and provincial assemblies since 1866 the economic affairs of their respective and to them are due much of the reformed since that date. The country is divided into *mirs* or communes, which have administration of local affairs. It nominally preserved its ancient constitution a national parliament of four estates, really governed by a governor-general appointed by the emperor. It was finally incorporated with Russia in a voluminous code, called the *Svod* Corpus Juris, has been drawn up for and declared to contain the law of the empire as far as not modified by the laws and particular provinces. It contains of all the laws and ordinances issued by different emperors from 1649 downward 15 large volumes. The laws and ordinances are full, but reaching only to 1832, are 56 volumes; of this immense collection of laws belong to the first seven years of the Emperor Nicholas I.

Language.—The Russian is by far the most important of the Slavic languages and is in close connection with the other languages of that family. Its underlying elements but there are additions from Mongolian and French sources as well as from classic languages. It may be divided into dialects, the Great Russian and the Little Russian, the first being the vernacular and centre of the empire, the second in the Ukraine. The Russian is a highly inflected language, possessing seven cases, and a number of modal modifications for the especially rich in augmentatives and diminutives, which, upward or down, may be carried several degrees of intensity. A still more curious source of word formation is the facility of the roots to manifold derivations that according to Shishkof as many derivatives are often formed from a single root. A great freedom of construction is re-

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sible by the free use of inflections. The standard dictionaries are Dahl, 'Dictionary of the Russian Language'; and the 'Dictionary of the Church Slavonic and Russian Languages' (1847), a new edition of which is now in the course of publication under the direction of the Imperial Academy of Science. The most important work on the grammar of the language is that of Bousslayeff (1881). In English there are: Alexandroff, 'Complete Russian-English and English-Russian Dictionary' (1897-9), and 'A Practical Method of the Russian Language' (1892); Riola, 'How to Learn Russian'; Motti, 'Russian Conversation Grammar.'

History.—The foundation of the Russian empire is assigned by the earliest chroniclers to Rurik (q.v.), a Scandinavian chief, who about the year 860 established himself in the city of Novgorod, summoned thither by the Slav inhabitants to bring peace to a country distracted by civil strife. A part of the Varangians, as the Northmen were known to the Slavs, advanced south and established themselves in Kiev. Rurik was succeeded in 879 by his infant son Igor, but the government was in the hands of his kinsman Oleg, who extended the Varangian power to the west and south and in 882 made himself master of Kiev, leading thence a victorious expedition against Constantinople. Igor (912-945) made an unsuccessful expedition against the Byzantines and fell in battle against one of the rebellious Russian tribes, being succeeded by his son Sviatoslaff (945-972). During half of his reign he remained under the tutelage of his mother Olga, who about 950 embraced the Christian faith. Sviatoslaff waged successful war against the Bulgarians, but met with defeat at the hands of the Byzantines and perished during a revolt of the Petchenegans. The empire was divided among his three sons, with resulting confusion, till unity was restored by Vladimir the Great or the Saint (980-1015), who, an ardent pagan in his early life, embraced Christianity about 988 on receiving in marriage Anna, sister of the Byzantine emperors, Basil II. and Constantine. Soon the nation followed the example of its ruler, who was zealous in the extension of the new faith, Kiev became the seat of a metropolitan, and Russia, in adopting the Greek confession, definitely submitted to the influence of the Byzantine civilization. Vladimir left a realm extending from the northern lakes to the Dnieper and from the Vistula to the Volga, for his eight sons to quarrel over. One of them, Sviatopolk, ruled in Kiev till 1019, but was overthrown by his brother Yaroslaff, whose power after 1034 was undisputed. Under him the process of assimilation between Varangians and Slavs attained fair completeness and we have the beginning of the modern Russian people. Yaroslav divided his dominions among his five sons who ruled at Kiev, Vladimir, Smolensk, Tchernigov, and Peryeslavl, with the ruler of the first as over-lord. This arrangement lasted but a short time and there followed 50 years of confusion, in the course of which the empire was torn up into numerous principalities whose strife prepared the way for a foreign conqueror. Noteworthy among the grand-princes of Kiev of this period are Sviatopolk (1093-1113), who waged long wars against the Polovtser, and Vladimir

Monomachus (1113-25), who did much to improve the condition of the peasantry. Of the Russian principalities which arose about this time the most important were Kiev, which exercised an indefinite overlordship over the other states; Novgorod, extending from the southern Dvina and the upper Volga to the White Sea; Polotsk to the southwest of Novgorod; Smolensk to the south of Polotsk; Volhynia and Halicz in the west; Tchernigov between the Dnieper and the Oka; and Susdal on the upper and central Volga. Of these Novgorod (q.v.) was the most powerful under a government which was essentially republican. It was also the richest of the Russian cities and an influential member of the Hanseatic League. In 1222 the storm of Mongol invasion broke upon Russia and in the following year the princes of Kiev, Halicz, and Tchernigov were defeated in a great battle on the Kalka. The full force of invasion, however, did not come till 1237, when Batui-Khan (q.v.) with an immense army entered Russia, took Ryazan, Vladimir, and Moscow, and overthrew the army of the Prince of Vladimir on the river Siti in 1238. By 1240 all Russia with the exception of Novgorod had been reduced and in 1242 it was placed under the authority of the Golden Horde or Khanate of Kiptchak, whose rulers made and unmade princes at their will, though no attempt was made to intervene in the internal affairs of the various principalities. The country, which had suffered fearful devastation during the conquest, was now ground down by heavy impositions of tribute, and all attempts at throwing off the foreign yoke met with bloody retribution. Novgorod, the last of the Russian principalities to submit, fell toward the end of the 13th century. The effect of the Mongol conquest on the state of civilization in Russia was deplorable and may be said to have rendered that great empire what it still remains, the most backward country of Europe, after Turkey.

Kiev and Tchernigov had been destroyed during the wars of Batui-Khan and the centre of power now shifts to the north where Vladimir for a time was the most important of the Russian principalities; the most noted of its rulers was Alexander Nevski (1252-63), who won notable victories over the Swedes and the Livonian Sword Bearers. The succeeding period witnessed Russia's deepest degradation brought about by internal strife among the princes whose dissensions served only to fix the Mongol yoke more firmly on the people. Vladimir in the course of time yielded precedence to Tver and Moscow, between which a long contest ensued for supremacy, ending in the triumph of the latter, whose period of ascendancy begins with the Grand Prince Ivan Kalita in 1328. Ivan beautified Moscow, built the Kremlin, and by winning the favor of the Khans retained the succession in his family. His son Simeon the Proud (1340-53) extended the power of Moscow, and Simeon's grandson Dmitri (1362-83) thought himself strong enough to rise against the Mongols, over whom he gained a splendid victory on the Don in 1380, acquiring thereby the surname Donskoi. Moscow, however, was taken and burned and Dmitri was forced to renew his allegiance to the Khan. His son Vassili II. (1389-1425) raised the power of

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Moscow to a higher point than ever and under his successor Vassili III. (1425-62) great increases in territory were made by the annexation of neighboring principalities in spite of long years of civil confusion. The power of Moscow was still further increased by the disruption of the Khanate of Kiptchak into a number of independent hordes or khanates, among which the Khanate of Kazan was brought under the authority of Moscow by Ivan III. the Great (1462-1505), who in 1478 reduced Novgorod and in 1480 helped to overthrow the Khan of the Golden Horde, whereby Russia was freed from the Mongol yoke. In 1472 Ivan married Sophia, niece of the last Byzantine emperor, and, pretending to imperial honors, assumed the title of Grand-Prince and Autocrat of Russia. He made an attempt to introduce western civilization into Russia but proved less successful as a reformer than as a warrior. At his death he left a realm increased nearly fourfold by conquest in the east, the south, and the west. His son Vassili III. (1505-33) furthered the introduction of the European arts. He left an infant son Ivan IV. (1533-84), who grew up in the unfavorable atmosphere of a dissolute court and assumed personal power in 1547 at the age of 17, first making use of the title Czar. Ivan overthrew the Khanates of Kazan and Astrakhan and waged repeated wars with the Tartars of the Crimea, who in 1571 raided and burned Moscow and carried off an immense number of prisoners. He attempted to gain an outlet for Russia on the Baltic but failed against the hostility of Sweden and Poland. The establishment of commercial intercourse with England by way of the White Sea led to the coming of large numbers of western artists and mechanics who were welcomed by Ivan. In his reign, too, began the conquest of Siberia (q.v.) by the Cossack Yermak. Within the realm Ivan devoted himself to crushing out the privileges of the Boyars or nobility and to render his will absolute in every field. He succeeded in attaining his end by acts of the most fearful cruelty which earned for him the name of the Terrible. Novgorod, which attempted to make common cause with Poland, was stormed and subjected to massacre and plunder for five weeks, in the course of which 60,000 of the inhabitants are said to have perished. Ivan IV. was succeeded by the weak Feodor I. (1584-98), who left the affairs of government to his brother-in-law Boris Godunoff. The latter, aiming at the throne, brought about the death of Feodor's younger brother Dmitri, and on the death of the Czar (the last Rurik) was elected to succeed him. His rule (1598-1605) was unpopular and widespread dissatisfaction provided the opportunity for the appearance of a number of pretenders claiming to be the murdered Dmitri. The first of these, with the aid of the Polish king, overthrew Boris in 1604 and on the latter's death in the following year, was crowned at Moscow. He was dethroned and killed in the following year and Vassili Shiuski was chosen to the throne. A new pretender now appeared, Vassili was forced to abdicate, a faction of the Boyars chose Ladislav, crown prince of Poland, for their ruler, and a Polish army took possession of Moscow. There followed two years of anarchy till a national uprising headed by Minin and Pozharsky drove the Poles from the capital (1612), where-

upon Michael Romanoff, a youth of 17, was chosen to the throne by a representative assembly (1613).

The new Czar, who during the first part of his reign was under the influence of his father, the patriarch Feodor Philarete, devoted his energies to restoring order to the distracted country and concluded peace with Sweden and Poland at the cost of much Russian territory. Michael died in 1645 and was succeeded by his son Alexei Mikhailovitch (1645-76), under whom a popular revolt occasioned by the misgovernment of certain court favorites led to a thorough reform of the laws and the administration of justice, effected by the enactment of a new code, the *Uloshenie*. In the war between Sweden and Poland, which broke out in 1653, Russia, as the ally in turn of either party, met with final defeat at the hands of Sweden. From Poland, however, it obtained by the treaty of Andrussow in 1669, Little Russia east of the Dnieper, Kiev, and Smolensk. The changes effected at this time by Nekon, the patriarch of Moscow, in the dogma and ritual of the Church, though accepted by the majority of the nation, created the sect of Old Believers or Raskolniki (q.v.), who carried their hatred of innovation into the secular field and sought to combat the introduction of western civilization into the country. Alexei was succeeded by his eldest son Feodor Alexeievitch (1676-82), who continued the reform policy of his father by abolishing the old nobility of office and creating a new aristocracy in its place. Upon Feodor's death without issue, his half-brother Peter, a child of 10, was chosen Czar in accordance with the dead monarch's will. Ivan, a full brother of Feodor and a youth of 16, was passed over because of his mental infirmities. A revolt in his favor, however, led to the acknowledgment of both brothers as co-rulers under the regency of Ivan's sister Sophia, a woman of great ambition and power of will, who entered into an unsuccessful war with Turkey, repressed a rising of the Old Russian party, and the Raskolniki and, when Peter, with advancing years, began to assert his authority, plotted to bring about his death with the aid of the Streltsi, the body of royal troops first organized by Ivan the Terrible. Peter escaped from the power of the Regent and in the brief struggle which followed, Sophia was overthrown, the Streltsi were severely punished, and as Peter I. (1689-1725) the founder of Russia's greatness as a European power began his reign. Ivan retained the title of Czar till his death but exerted no influence in the government. Given in detail under his own name, Peter's services to his nation may here be closely summarized. Externally he made it his life's task to gain for Russia an outlet on the western and southern seas, the only seaport in the empire at that time being Archangel on the ice-covered White Sea in the north. The conquest of the Black Sea coast land began with the capture of Azov in 1696. A short period of peace during which the young Czar repressed a formidable uprising of the Streltsi, destroyed that famous corps and organized an army on the western model, was followed by Russia's entrance into the northern war as the ally of Poland against Sweden. Peter's army was badly beaten by Charles XII. at Narva, in 1700, but the Czar profited by ill-success, reorganized his forces, and at Pultova in 1709 over-

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threw Charles, who was forced to seek refuge with the Sultan. The latter was incited to war against Russia, and in 1711 Peter, caught with his army in a trap on the Pruth River, was forced to purchase peace by the surrender of Azov. In the north, however, the Russian fortunes had prospered. Shortly after Narva Peter had made himself master of parts of Esthonia, Livonia, and Ingria, and in 1703 had laid the foundation of his new capital, Saint Petersburg, on the banks of the Neva, in territory conquered from the Swedes. By the treaty of Nystadt, in 1721, Russia was confirmed in possession of these Baltic lands, and secured in addition parts of Carelia and Finland, succeeding thus to Sweden as the leading power in the north of Europe. A three years' war with Persia during the last part of Peter's reign resulted in the conquest of a portion of the southern coastland of the Caspian Sea. Internally Peter's efforts were directed to the introduction of western civilization into his dominions and to a very great degree he was successful. The industries, schools, and arts of western Europe were brought in and forced by the Czar upon an unwilling people for their good. Far less successful was his attempt to engraft western refinement and habits of thought on a nation whose ideals were half patriarchal and half Oriental. The anomalies of the Russian character, which at the present day present so much that is puzzling to the western mind, may be traced to this artificial amalgamation process pursued by Peter the Great. To enforce his will, the Czar must of needs be absolute within his dominions and Peter carried the centralization of power to the extent of abolishing the patriarchate and vesting the ultimate control of the Church in his own person.

Peter's only son Alexei had died during his father's lifetime, and the crown passed to the wife of the dead monarch, Catharine I., who was succeeded in 1727 by Peter II., a son of Alexei. On Peter's death in 1730, the Privy Council, in which the influence of the families of Galizyn and Dolgorouki was predominant, called to the throne Anna Ivanovna (1730-40), Duchess of Courland and a daughter of Peter the Great's half-witted brother Ivan. Defeating an attempt of the aristocracy to limit her powers, she left the affairs of government to her favorite Biron, a native of Courland, who soon aroused the hatred of the Russian party. A war with Turkey in 1735-9 resulted in the permanent acquisition of Azov, but at the same time Peter's conquests in Persia were abandoned. Anna Ivanovna died in 1740, leaving the throne to her infant grand-nephew Ivan (1740-1) under the regency of Biron. The latter, however, was speedily overthrown and Anna Leopoldovna, mother of the young Czar, became Regent with Marshal Münnich (q.v.) as her chief adviser. A conspiracy headed by the French ambassador at Saint Petersburg brought about, in the same year, the fall of Anna Leopoldovna and the entire German faction, and the elevation to the throne of Elizabeth (1741-62), the daughter of Peter the Great. Under the influence of England, Russia entered the war of the Austrian Succession as an ally of Austria and in the Seven Years' war, Elizabeth's hatred for Frederick the Great made her a bitter opponent of Prussia. The Russian armies gained victories over Frederick's generals at Gross jagersdorf

(1758), and Kunersdorf (1759), raided Berlin in the following year, and overran East Prussia. This reign is noted for the progress made in the spread of education and general culture. The University of Moscow, the first in Russia, was founded in 1755. Elizabeth was succeeded by Duke Peter of Holstein-Gottorp, a son of Peter the Great's second daughter Anna, who in less than a year fell a victim to a conspiracy of which his wife, Catharine, was the leading spirit. After Peter's death by violence, Catharine, the second of that name, ascended the throne, one of the most dissolute women of her time and one of the greatest rulers of all times. During her long reign (1762-96) Catharine II. labored incessantly for the internal development of the empire. Commerce and industry were encouraged, education was furthered, the laws and the systems of administration were reformed. Abroad the power of Russia was tremendously enhanced at the expense of Poland and Turkey. In the dismemberment of the former (see POLAND) Catharine was the leading spirit and by the threefold partition of that country, enormous territorial gains were made. In the first war with Turkey (1768-74) Russia acquired the land between the Dnieper and the Bug and the right of free navigation on the Black Sea. The Sultan renounced his overlordship over the Crimea, which soon after fell to Russia. In a second war (1787-92) Russia acquired the land between the Bug and the Dniester. Courland was annexed in 1795 on the death of its last duke. Catharine II. was succeeded by her son Paul I. (1796-1801), whose tyrannous acts, proceeding rather from a gloomy suspiciousness of character than innate cruelty, aroused general dissatisfaction. He was assassinated by a number of the highest dignitaries of the court and the crown passed to his son Alexander, who had been a party to the projected dethronement of his father, though possibly not to his murder.

Alexander I. (1801-25) devoted the first year of his reign to carrying into effect the lofty ideals of government implanted in him by his tutor La Harpe (q.v.). Reforms in administration and the laws were enacted, the finances were partially reorganized, education was encouraged, and the condition of the serfs ameliorated in part. In the Baltic provinces villeinage was abolished. Soon, however, the Czar found himself drawn into the vortex of the Napoleonic wars. Paul I. had entered the struggle against the French Republic and the victories of the Russians under Suvaroff in northern Italy (1799) had driven the French from that region. Later Paul had withdrawn from the coalition and with Sweden, Prussia, and Denmark had formed the armed neutrality of the North aimed against the pretensions of Great Britain. Alexander I., on his accession, had made peace with England and now, in 1805, he joined the third coalition against France. The Russians shared in the disastrous defeat at Austerlitz, and in 1807, as an ally of Prussia, suffered a crushing defeat at Friedland (q.v.). In the peace of Tilsit Alexander I. and Napoleon came to terms whereby the former, in return for abstaining from intervention in the affairs of western Europe, was permitted to work his will on Sweden and Turkey. Finland was wrested from Sweden. Turkey after a six-years' war (1806-12) was forced to cede the lands east of the Pruth,



NICHOLAS II, CZAR OF RUSSIA.

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ment loans were set on the way toward acquiring ultimate possession of the lands they cultivated. Naturally the act of emancipation was not unaccompanied by disorder and dissatisfaction consequent on the sudden change from servitude to the responsibilities of freedom on the part of the peasants and in a number of ways the results were not so beneficent as had been expected; yet the liberation of the serfs was a great step forward in the development of the Russian people. It was followed by judicial reforms comprising the establishment of jury courts and by the institution of district and provincial assemblies which were intended to prepare the way for a national parliament on which all hopes of a thorough reform in the state were based. In 1863 the Poles rose in insurrection and though the uprising assumed no very formidable proportions, the strength of Russia was tried in its suppression. Like the uprising of 1831 the Polish insurrection of 1863 was followed by a great awakening of the Russian national consciousness, which took the form of a demand for the development of Russia not on western lines but in accordance with its own ethnic genius. This outburst of patriotism threw the reform movement in the background and the problems of emancipation failed to receive sufficient attention from the bureaucracy with consequent dissatisfaction among considerable classes of the population. The Nihilists (q.v.) began to agitate ideals of radical individualism and the reorganization of the state, and when the government sought to repress their activity a faction among them resorted to terrorism to bring about constitutional reforms. In 1878 began a series of personal assaults on high officials of state which led to correspondingly severe measures on the part of the government. Military rule became general in the empire and the secret police hunted down the leaders of the Nihilists who were punished with death or exile. Yet Alexander II., under the guidance of Loris-Meleikoff (q.v.), was planning to meet the demands of the Liberals by summoning a national assembly, when he fell a victim to the anger of the Nihilists, 13 March 1881. The progress of the Russian arms during the reign of Alexander II. was of the utmost importance. The conquest of the Caucasus was completed in 1864, and central Asia came under the Russian authority (Tashkent, 1867; Samarkand, 1868; Khiva, 1873; Khokand, 1876). By the treaty of Aigun (1858) China ceded to Russia the territory of the Amur. In Europe the Czar, for services rendered Germany in 1870-1, succeeded in obtaining in return, the abolition of those provisions of the treaty of Paris (1856) which restricted the Russian power in the Black Sea. Revolts in Herzegovina and Bulgaria in 1875-6 led the Panславists in Russia to demand intervention in behalf of the Christian population of the Balkans oppressed by the Turkish power. In 1877 Russia declared war against Turkey and a simultaneous attack was begun on the Turkish power in Europe and the Caucasus. On 27 June the Russians crossed the Danube and on 13 July Gen. Gurko crossed the Balkans and advanced to within two days' march of Adrianople. The Russian fortunes then suffered a reverse. Osman Pasha (q.v.) held out in Plevna for 20 weeks against repeated assaults until all hopes of successful resistance were gone (10 Dec. 1877).

Gurko, too, had been driven back, but in the end of December he recrossed the Balkans, and being joined by a second army which on 9 Jan. 1878 captured the Turkish forces at Shipka Pass, made an end of Turkish resistance at Philippopolis, 17 January, occupied Adrianople, and advanced on Constantinople. On 3 March Turkey concluded the Peace of San Stefano, by which Russia acquired a part of Armenia with Ardahan, Batum, and Kars. The independence of Rumania, Servia, and Montenegro was recognized by the Porte, and an autonomous Bulgarian state, extending to the Aegean Sea, erected. The terms of the treaty of San Stefano were radically modified, however, at the Congress of Berlin (q.v.) in the same year.

Alexander II. was succeeded by his son Alexander III. (1881-94), whose reign marked a sharp reaction from the liberal ideals of his father. The Czar was under the influence of the reactionaries Ignatieff, Pobiedonostseff, and Katkoff, the leader of the Old Russian party. The Nihilists were persecuted relentlessly and their repeated attempts on the life of the Czar only confirmed the monarch in his repressive course. The universities were placed under strict supervision and the policy of crushing out all nationalities within the empire but the Russian and all religions but the Orthodox was ruthlessly carried out. The censorship was re-established in all its severity. Within two or three years after the accession of Alexander III. terrorism had been well suppressed, but the subsequent development of a revolutionary labor movement took place in spite of the activity of the police. Under Nicholas II. (1894-) the policy of reaction was continued though in a somewhat modified form. The new ruler was still under the influence of Pobiedonostseff, head of the Holy Synod, and other advocates of repression against whose ascendancy his naturally enlightened impulses could but rarely assert themselves. We may find the Czar's initiative in the rescript of 1898 issued to the nations of the world and calling on them to take steps leading toward disarmament and the establishment of permanent international peace. This was followed by The Hague Peace Conference and the erection of an international court of arbitration at the Dutch capital. The policy of Russification begun under Alexander III. was steadfastly pursued under his successor, the chief field of activity being the Baltic province, Poland, and more prominently Finland (q.v.). In close connection with this policy stand the laws of exception against the Jews who, beginning with 1881, have been subjected to almost unrelenting persecution. When Finland passed to Russia in 1809 Alexander I. had guaranteed the preservation of its autonomy and its language and religion. But, though this guarantee has been renewed from time to time, it did not prevent the Russian government from beginning a determined attack on the liberties of the country. The process reached its height in 1902 when the authority of the Finnish Senate was rendered subordinate to the governor of the duchy appointed by the Czar, who at the same time was given control over the entire administration. Russian was made the official language and the destruction of the Finnish tongue was sought by the suppression of newspapers and periodicals on supposedly political grounds. All

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attempts at resistance on the part of the Finns have been sternly repressed by Governor Bobrikov, and it is only a question of time when Finland shall have lost her liberties as Poland has lost hers. Milder methods of a similar nature have been pursued in the Baltic provinces where Russian has been made the language of the courts, the schools, and the universities, and even the ancient names of well known cities have been changed from German into Russian. In 1882 came the May laws, brought forward by Ignatieff, imposing numerous restrictions on the Jews in respect to rights of residence and occupation, admission to educational institutions, and eligibility to public office. Most oppressive of these provisions is the one forbidding them residence in the greater part of the empire and concentrating them within the Pale of Settlement (15 provinces) in the western provinces, where, crowded together in the towns, the great mass of them has sunk to an abject economic condition. The spirit of anti-Semitism has grown among the Russian population owing to conceived objectionable traits of Russian Hebrews, but it must be admitted that to the agitation of anti-Semitic journalists and the deliberate policy of the government must be ascribed such popular anti-Jewish outbreaks as occurred in May 1903 at Kisheneff, when more than 50 Jews and a number of Christians lost their lives.

The appointment of men like Bobrikov as governor of Finland and Sipiagin as minister of the interior had shown clearly that the government intended to pursue the old policy of repression of liberal movement, and the revolutionary party again resorted to their former and favored means of retaliating the despotic measures of the government. Within the short space of two years quite a number of political murders have been perpetrated. Minister of Public Instruction Bogolepoff was killed by a student Karpovitch, soon after Minister of the Interior Sipiagin was killed also by a student, Stepan Balmashev. The revolutionary propaganda spread like fire throughout Russia and resulted in continuous strikes, riots and uprisings of peasants. In the provinces of Poltava, Kieff and Charkov peasants rose up against the landed proprietors, burned their estates and accompanied these acts by robbery and violence. Troops were sent against them and these insurrections were suppressed with ruthlessness and cruelty, reminding of the Dragonades under Louis XIV., whole villages having been given to the rapacity of soldiers. Finally the peasants were flogged into submission. In Zlatoust, Ufa province, on the Ural Mountains, the strikes assumed such proportions that the troops sent there had to kill and wound about 500 workmen. The cruelty in suppressing the strike cost the governor of the Ufa province, Bogdanovitch, his life, he having been murdered by the revolutionists in the public square of Ufa. In the beginning of 1904 the oppressive policy of General Bobrikov in Finland reached the point when patience ceased to be a virtue and he was shot dead within the walls of the Finnish Senate by the son of a general in the Russian army and a Finnish Senator, Schaumann, who, immediately after the deed, committed suicide. Only two months passed after the assassination of Bobrikov, when Minister of the Interior von

Plehve, who succeeded Sipiagin, was blown up by a dynamite bomb in the streets of Saint Petersburg. Numerous other attempts on the lives of the government officials took place within the last twelve months. Disturbances en masse occur every day and to this are now being added the riots of the reservists who are called to the army and who do not relish the prospect of being made food for powder. The tremendous expenditure of money necessitated by the war compels the government to resort to measures for increasing the revenue, which are not only burdensome upon the impoverished and almost starved population, but are enforced in the way which is repulsive, even to the materially better classes. The commercial depression, the unrest of the population, evident unpopularity of the war with Japan—no doubt had much to do with the selection from a different class of a successor to von Plehve.

The new minister of the interior, Prince Sviatopolk Mirski, is a man of liberal mind, kind hearted, of the highest honor and a scholar. After his appointment, all of a sudden, the press obtained fairer treatment, political exiles have been returned, and the arbitrary dealing with political suspects discontinued. The articles on the burning questions of the day, which now appear even in semi-official papers like 'Novoe Vremia,' are of such character that, under the regime of von Plehve, the writer would have been furnished with a free ticket to the remotest and most desolate part of Siberia and the paper suppressed. More than this, Prince Sviatopolk Mirski has arranged a meeting at Saint Petersburg of the presidents of the Zemstvos of all provinces for the discussion of different subjects with the ultimate purpose in view of putting an end to the present awful state of things in Russia. All the presidents presented their views in a memorial which is submitted to the Czar. The main demands of the Zemstvos are: freedom of the press, speech and conscience; equality of every subject before the law and discontinuance of the arbitrary actions of the officials by making them responsible for their actions before the people. This meeting of the representatives is a thing unprecedented in the annals of the Russian history. It reminds somewhat of the calling of the notables in France in the reign of Louis XVI. Should the Czar refuse to grant the reforms asked by the Zemstvos—the course adopted by Louis XVI.—something startling will take place in Russia. It is rumored that Sviatopolk Mirski declared he would resign should the request of the Zemstvos be ignored.

The foreign policy of Russia since 1881 has been of prime importance in the field of European and Asiatic politics. Alexander III. was a lover of peace and during his lifetime he remained a power for peace on the continent. Affairs in Bulgaria where the Russian schemes were frustrated by the influence of Austria and Germany, threatened war for some time after 1885, but led to no hostilities. The formation of the Triple Alliance was followed by a rapprochement between Russia and France which began to take on a more formal aspect after 1891 and resulted in the conclusion of a defensive alliance. In Asia, however, Russia's policy has been one of constant aggression. Its hold on Turkestan had been firmly fixed by 1881 and

this was followed by the acquisition in 1884 of Merv, which brought the Russian power in close touch with the sphere of English influence in Afghanistan. In Persia, too, the Russian influence has been exerted toward gaining an outlet on the Asiatic waters. Conquest was consolidated by the building of railways of which the greatest is the Siberian railway planned to connect Saint Petersburg with the Pacific. The appearance of Japan as a factor in Asiatic affairs after her victory over China in 1894-5 aroused Russia to renewed efforts in the Far East. Through the intervention of Russia and Germany, Japan was deprived of its conquests in Manchuria, and in 1898 Russia by a lease from China secured possession for 26 years of the harbors of Port Arthur and Ta-lien-wan in the Liao-Tung peninsula, the very territory of which Japan had been forced to surrender possession. Port Arthur was very strongly fortified and the new port of Dalny built to take the place of Vladivostok as Russia's great ports on the Eastern seas, the last being ice bound during a considerable part of the year. The construction of the Manchurian railway connecting the newly acquired possessions with the main line of the Siberian railway was begun. During the Boxer uprising of 1900 the Chinese attacked the Russian town of Blagovyeschensk on the Amur River, in retaliation for which a Russian force invaded Manchuria, which, after sharp fighting, was overrun and occupied. By a convention between Russia and China, signed in April 1902, the former agreed to retire from Manchuria within 18 months. The sincerity of the Russian intentions, however, was open to doubt; the time was employed by them in increasing their forces in the country and strengthening the fortifications at Port Arthur and Dalny, and when the time for the evacuation of the country had arrived plausible reasons were brought forward for a continued occupation. At the same time Russia evinced a disposition to restrict the commercial rights of foreign nations in Manchuria. This aroused the jealousy of Japan, which deemed its paramount interests in Korea threatened by Russia's aggressive action. Negotiations between the two countries, relative to the situation in Korea and Manchuria, were begun in the fall of 1903 and were prolonged by repeated delays on the part of Russia, till the beginning of February 1904, when it became apparent that war was inevitable and that the purpose of Russia was probably to gain time for strengthening its position in Manchuria. In the first days of February Japan severed diplomatic relations with Russia and hostilities were begun on the night of 7-8 February. During the 18 months of war with Russia, the Japanese showed themselves to be the superior of the two, both on land and sea—on land defeating the Russians and compelling them to retreat as far north as Tie-Ling, and on sea by practically destroying the whole of the Russian fleet in the Eastern waters. The only resistance on the part of the Russian forces worth mentioning was the defense of Port Arthur, where the gallant General Stoessel (q.v.) won undying fame. The losses in men during these 18 months on both sides were enormous, in the battle of Liaoung alone where the number of combatants reached the

enormous figure of half a million, the losses in killed and wounded were counted to be over 100,000 men. The Russian government did not admit any other end of this war except complete victory for Russia, but the Japanese proved themselves superior to the Russians in every respect and, after decisively winning every important battle, concluded peace 5 Sept. 1905. See MANCHURIA; PORTSMOUTH, TREATY OF.

Meanwhile, the whole country was in a state of political ferment and almost anarchic disturbance. Strikes, mutinies, assassinations, mass meetings, demonstrations, and petitions asking for representative government, liberty of assembly, speech, and person, caused ceaseless agitation throughout the empire. The bureaucracy continued its policy of ruthless repression, imprisonment and exile, and many peaceable demonstrations were turned into scenes of massacre, notably that in Saint Petersburg of 18 Jan. 1905, headed by Father Gapon (later, privately hanged for treachery, by his own party). In the provinces, at Moscow, Warsaw, Riga, Odessa, Reval, Lodz, Radom, and Kovno, disturbances broke out, the educated and professional classes joining with the industrial and agricultural masses in the demand for representative government. In the Caucasus a state of civil war existed between Armenians and Tartars. In Finland the diet refused to recognize the imperial decrees and the governor-general Bobrikoff and the procurator-general Johnsson, were assassinated. On 17 Feb. 1905, at Moscow, the governor-general, Grand Duke Serge, uncle of the Czar, was killed by an anarchist's bomb. A manifesto issued by the Czar on 3 March again ignored the popular demand for a National Assembly, and a general strike of workmen was ordered throughout the country, whereupon a rescript promising a Legislative Assembly was published the same day. At Easter the Czar conferred religious freedom on over 52,000,000 subjects of many faiths, giving equal rights with the orthodox, to Old Believers, Jews, Catholics, Protestants, Buddhists, and Mohammedans. In May and July, congresses representing the zemstvos or elective provincial assemblies, and the municipalities, had assembled at Moscow, and prepared a draft constitution for presentation to the Czar, urging upon him the imminence of a revolution and the desirability that the promise of a constitution should be at once fulfilled. On 19 Aug. the Czar issued a manifesto creating an elective state council (Gosoudarstvennaya Duma), and regulations for elections to the Duma were submitted. On 25 Sept. a Zemstvo Congress was again held at Moscow, which criticized the National Duma to be convoked according to the law of 19 Aug. as not national representation in the correct sense of the word, and declared that representation should be on a national and not a class basis, the election of the representatives being by universal and direct suffrage. In October, the whole country was in a state of passive revolt; an organized strike on railways, gas and electric lighting plants, and other large industries, to enforce purely political demands, compelled the government to accede to the desired reforms. On 30 Oct. the Czar signed a constitution and appointed Count Witte as Prime Minister of a responsible ministry.

The law as promulgated grants the popula-

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tion the firm foundations of civic liberty, based on the principles of inviolability of the person, and of freedom of conscience, speech, assembly and association, and established as an immutable rule, that no law shall come into effect without the approval of the Duma, and that to the elected of the people shall be guaranteed the possibility of a real participation in the control of the legality of the acts of such authorities as are appointed by the Czar. Provision is also made that the members of the Duma representing the governments or provinces and the greatest cities (Saint Petersburg, Moscow, and 26 others), shall hold office for five years, unless the Duma is dissolved by the Czar. The Duma may elect a President and Vice-President annually, and conduct its proceedings in general session and in sections. Ministers and chiefs of Departments cannot become members, but may attend the sessions. Members receive 10 roubles per day and traveling expenses. The election of deputies was indirect, and made by electoral bodies of the chief towns of governments or provinces and of the greatest cities, composed of delegates chosen by the district or town elective assemblies.

The Council of the Empire was reorganized and changes made in the constitution of the Duma under a manifesto and ukases published 6 March 1906. The Council of the Empire as now established, consists of an equal number of elected members and members nominated by the Czar, and is convoked and prorogued annually by Imperial ukase. The Council of the Empire and the Duma have equal legislative powers, and the same right of initiative in legislation and of addressing questions to Ministers. Every measure before being submitted for the Imperial sanction must be passed by both the Duma and the Council of the Empire, and all such as are rejected by one of the two legislative institutions will not be laid before the Czar. Both the Duma and the Council have the right to annul the election of any of their members. The elective members of the Council will be eligible for nine years, a third of the number being elected every three years. Each Assembly of the Zemstvo of each government or province will elect one member. Six members will be returned by the Synod of the Orthodox Church, six by the representatives of the Academy of Sciences and the Universities, 12 by the representatives of the chambers of commerce and industry, 18 by the representatives of the nobility, and 6 by the representatives of the landed proprietors, assembled in Congress at Warsaw. In the provinces of European Russia which have no Zemstvo, a Congress of the representatives of the landed proprietors assembled in the chief towns of their province to elect one member for each province to the Council of the Empire.

All members of the Council must have attained their fortieth year and possess an academic degree. The President and Vice-president are appointed by the Czar. The elective members of the Council receive an honorarium of 25 roubles (\$12.50) a day during the sessions. The sittings of both the Duma and the Council of the Empire are public. The closure of a debate may be voted by a simple majority. Neither the Council of the Empire nor the Duma is empowered to receive deputations or

petitions. Ministers are eligible for the Duma, and, in the capacity of elected members, are qualified to vote.

Laws voted by the two Houses are submitted for the Imperial sanction by the President of the Council of the Empire. The members of both institutions have the privilege of personal immunity during the session. They are only liable to arrest with the permission of the Duma or the Council of the Empire, according to circumstances, except in cases of flagrant offenses or offenses committed in the exercise of their duties. The ukases further provide that bills rejected by one of the legislative bodies cannot be brought forward again without the Imperial consent.

Zemstvo representatives, however, refused to support the Witte cabinet, and their action was endorsed by a Zemstvo congress assembled at Moscow. The Czar appointed Prince Goremekin to succeed Count Witte and the Russian Parliament was opened by the Czar, 10 May 1906, with gorgeous ceremony. The proceedings were marked by great distrust, which also characterized subsequent parliamentary proceedings, the strong opposition of the Court and bureaucratic party to all reform measures being confronted by the persistent tenacity of the national party. While universal suffrage was conceded, the Duma's solution of the agrarian problem was refused, and only a partial amnesty of political offenses granted. The policy of repression continued and the bureaucracy was openly charged with organizing and arming the baser elements of the nation, to incite them against the progressive elements of society, against intelligence, against students, workmen, and Jews. Instigated for reactionary purposes, it was alleged, pogroms or riots in which anti-Jewish outrages of the most horrible character were the chief features, were allowed to go unchecked by the authorities. The records of the massacres at Warsaw, Odessa, Kazan, Rostoff, Kherson, Kishineff, Kieff, Tiflis, Sevastopol excited universal reprobation, while the Bialystok massacre in June 1906 evoked a condemnatory message passed by the Congress of the United States.

On 22 July 1906 the Czar dissolved the Duma, placed Saint Petersburg under martial law, and appointed Peter Stolypin to succeed Goremekin as Premier. The Duma members, meeting at Viborg, Finland, issued a manifesto to the Russian people urging them to refuse to pay taxes, or send conscripts to the army until the power of Parliament be restored. Mutinies of the Cronstadt and Sveaborg (Finland) garrisons were quickly suppressed and the general strike of the Workmen's Councils, declared on 3 August, was called off on the 7th owing to non-support.

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Russia Leather. See LEATHER.

Russia, Orders and Decorations. See ORDERS, ROYAL.

Russian Baptists. See STUNDISTS.

Russian Church. See GREEK CHURCH.

Russian Literature. In the compilation of works on the subject of Russian literature it has been usual to adopt the division of the same into different periods and to go back to early Russian history in search of monuments that may be used in supporting the opinion that Russian literature had its beginning in translations of certain Byzantine church works into old Slavonic, which was the exclusive church language. The heroic traditions, such as 'The Word of Igor's Band' or 'The Don River Slaughter' or the eloquent 'Letter of Vassian to Ioann III.,' are cited in support of the assertions that these productions mark the origin of Russian literature. That such historical documents, folk lore and scholastic eloquence have no more relation to ours than the monuments of antediluvian literature, had such been discovered, have to the Sanskrit, Greek or Latin literatures, is too obvious to need a proof. Russian literature undoubtedly commenced in 1739 when Lomonosov, who earned the nickname of "father of Russian poetry and patriarch of Russian poets," sent from abroad his ode on the 'Capture of Khotin.' Therefore it would be a thankless task for anyone interested in the Russian literature to attempt to find anything approaching the definition of the word literature in all the documents which we possess from the so-called Byzantine Greek period down to the end of the period of Western European influence (1113-1698). There are many reasons for this, such as the Tartar invasion, which actually destroyed the Russian national life,

but mainly the despotic form of government which obtained in Russia from the time of the Tartar domination down to our own times, and the influence of the orthodox church which, as a supporter of the despotic government, was always opposed to the free egress of human thought. It is a notorious fact that printing was introduced in Russia about 100 years after its discovery. The history of the Russian censorship is one of the blackest pages in the history of the Russian people, and the assertion of a gifted contemporary writer, Menshikov, that we hardly have any national literature, does not seem to be paradoxical in the least to the persons acquainted with the Russian censorship. The writers who speak of the revival of literature in the sixteenth century and cite as an example the correspondence between Ivan the Terrible and Prince Kurbski have very poor conception of the word literature, because the letters which passed between the insane despot and one of his subjects, who ran away from his insane fury, and found a refuge in Lithuania, should no more be considered literary documents of a country than scribbles of a cannibal king inviting his victims to get cooked. Even Kurbski in his answers to the Czar accuses the latter of being a bad grammarian and fully devoid of knowledge of the proper use of words and expressions. No doubt Peter the Great was instrumental in advancing the progress of the Russian thought and his reign was the precursor of the birth of Russian literature, but the names of early workers in this field are few and far between and, with the exception of Lomonosov and probably Karamzin, cannot be placed among the writers of note. Yet we are accustomed to hear among the names of poets of this epoch that of Trediakovski (1703-68), who at the best was a poor rhymester, whose writings, as our immortal Belinski said, remind us of the senseless dream talk of a sick man. Even what to a certain degree was considered poetical talent in Derjavin (1743-1816) at his epoch, now, in a contemporary writer, we would call prose and a lack of genius. And Derjavin was considered a poet of high attainments, who perfected lyric poetry. We may mention the names of other writers of this epoch such as Sumarokov (1718-77) who imitated, and badly at that, the theatrical plays of Corneille, Racine, and Molière; Fonvisin (1744-92), who is considered to be a satirical writer, but whose satires produce rather the feeling of pity and regret than laughter; Kniajin (1742-91); Novikov (1744-1818), all of these are not above mediocrity; besides Lomonosov only one other name deserving notice is that of Karamzin (1766-1826) who in his 'History of Russia' gave us the first readable and connected story of our historical past. Generally speaking the Russian literature of the eighteenth century and up to the present time has been and continues to be an imitative one. There is marked absence of originality, though commencing with Pushkin our poetry is original. The writers of the reigns of Anna Ioannovna, Elizaveta Petrovna, and Catherine II. are noted for their obsequious, servile style, which is explained by their having been almost wholly dependent upon the bounty and mercy of the reigning heads. Catherine II. encouraged literature, being herself somewhat of a writer, whose productions, however, beyond the fact that they

came from under the pen of a cr came from under the pen of a cr do not represent anything of ability. She was acquainted with the English and corresponded with Voltaire and Diderot to St. Petersburg, yet it she acquired but a superficial idea of the workings of encyclopædists, for, when (1749-1802), author of the celebrated 'Journey from St. Petersburg to Moscow,' depicted the terrible state of serfs under the hands of their owners and concluded by identical words of Robbie Burns, 'The inhumanity to man makes countless thousands mourn,' she declared him to be an instigator against the authorities and banished him to Siberia. And to this Russian literature owes more than any other writer, on account of his having been able to give the real basis to the philanthropy pervading Russian literature of the whole of the nineteenth century. Turgenev, Belinski, Herzen, and Chernyshevsky continued to carry high the banner of truth. We should not pass unnoticed the name of Jukovski (1783-1852), who, though not leave to posterity anything of great note, was one of the best translators of foreign literature, whose poetical translations, thanks to the richness and flexibility of the Russian language, are wonderfully original in German, French, and English. He was the first to avoid the use of stiff and affected Russian words and constructions, and to introduce language which was closer to the colloquial form. Alexander Pushkin (1799-1837) the Russian had first true representative of the principles; he was the first Russian who did not imitate and who was conscious of the originality of his writings. Of his best known are: 'Ruslan and Ludmila,' 'Prisoner of Caucasus,' 'Bakhtchisarai,' 'Robber Brothers,' 'Gypsies,' and 'Evgeni Onegin'; of his prose 'The Arab of Peter the Great,' 'Daughter,' and 'Dubrovski' are the most popular. As a writer of epigram he was unequalled. Among his contemporaries we mention Batiushkov, Baratynski, Delvig, and Koltzoff, who were his followers in the art of poetry. Koltzoff (1808-42) is known by his idylls from peasants' life, with so much tenderness, so much faith in the force of labor that one wonders that such could have been written during the reign of serfdom. Kryloff (1768-1844) is a fable writer, and Griboyedov whose comedy-satire 'Grief from Missin' in verse, and giving real pictures of high society in the beginning of the nineteenth century, will not be forgotten as long as the Russian language exists. Lermontov is another star among the Russian writers; his best of his poems are 'Demon,' 'The mail-Bey'; he also wrote a short story 'The Hero of Our Own Time,' which is popular. It is a noteworthy fact in the history of the Russian literature that but few of the most talented representatives escape the persecution of the government. Many of them to pass long periods in prison or exile, the most glaring instances of such are that of Polejaev (1805-38), who,

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spared to literature, would have been placed by posterity among our greatest poets. The whim of Nicholas I. sent the unfortunate man to a regiment in the Caucasus, to serve as a soldier, for a trivial offense, if it can be called an offense, of writing a poem 'Sashka,' which, though not very savory, was extremely well written. The intercession of many influential people did not procure his return from the exile where, not being able to endure the rigor of the military discipline, he died of consumption. The reign of Nicholas I., despotic as it was, can boast of several noted writers of whom Gogol (1809-52) is the most remarkable. His prose-poem 'The Dead Souls' gave a complete picture of the officialdom, of traits and manners of persons of every class in Russia in the first quarter of last century. His historical novel 'Taras Bulba' is the most successful novel ever written in Russian; his comedy 'Revisor' is considered a masterpiece of that class of literature. He would have been the most idolized writer in Russia had he not published his 'Selections from the Correspondence with Friends,' which at once destroyed the pedestal upon which he stood so high in the eyes of all intelligent Russians; the only good effect of this publication was that it produced the now famous letter of our immortal Belinski (1811-48) to Gogol. After Nicolai Polevoy (1796-1846), who was a pioneer of the critical literature of Russia, Belinski occupies the foremost place as the most gifted, fearless, and elegant critic Russia ever produced. His followers in this branch of literature were Dobroliubov (1836-61) and Pisarev (1841-68), and later on Michailovski, all of whom were very popular. The last years of reign of Nicholas I. form the most sombre period in the history of Russian literature. The oppression of the censorship was distressing, and though Russian literature did not succumb, it had a hard struggle for existence. And probably this struggle developed quite a number of talented writers. Foremost among them are Count Leo Tolstoi, Turgenev (1818-83), and Dostoevski (1822-81). Count Tolstoi's name is known throughout the world as that of a philosopher, philanthropist, writer, and champion of freedom, both religious and political, for the Russian people. His writings are very numerous, and it is hard to select from them one in which his genius appears at its best. Of his early writings 'War and Peace,' 'Anna Karenina,' and those of recent time 'Kreutzer's Sonata,' 'The Power of Darkness,' and 'Resurrection' are fair exponents of his genius. Of Turgenev's writings the best are 'Memoirs of a Hunter,' written when he was only 27 years of age, 'Fathers and Sons,' 'Virgin Soil.' Dostoevski's 'Memoirs from the Dead House,' 'Crime and Punishment,' 'Idiot,' and 'Humiliated and Abused' breathe with a profound love for all the oppressed, despised, and humiliated. Goncharov (1812-91) is mainly known by his admirable novel 'Oblomov,' in which he very artistically brought together all the repulsive traits of a landowner, brought up in the demoralizing atmosphere of serfdom, with the best and most attractive sides of a real Russian. Grigorovitch (1822-99) and Pissemski (1820-81), both of whom occupy honorable place in the literature, the former by his 'Anton Goremyka,' and the latter by his novel 'Thousand Souls'

and a realistic drama 'Sad Fate,' the most successful drama ever produced on the Russian stage. Another dramatist and playwright, Ostrovski (1823-86), presented to the public the unattractive character of the Russian merchant in all its nakedness. The best known of his plays are 'The Storm,' 'Poverty is no Vice,' and historical drama 'Vasilisa Melentieva.' The name of Alexander Herzen, a writer who did more than any other man in Russia for the liberation of the serfs, is now given an honorable place in the literature, though some 50 years ago, when he was editor of 'The Bell,' a Russian paper published in London, a letter from him, discovered by the police, was sufficient to have a man deported to Siberia. The most beloved poet of the epoch of great reforms, whose genuine poetry discloses such profound sympathy and love for the people, was Nekrassof (1821-77). Other poets who sang the sorrow of the peasant class were Nikitin (1824-61), Pletscheev (1825-93), Kurotchkin (1831-75), the latter, however, is better known as excellent translator of the songs of Béranger from the French. The Crimean war, exactly like the Russo-Japanese campaign, revealed a great mass of abuses in every department of the government, and produced the feeling of unstability of the whole administrative organism. This feeling found vent in the peculiar expository literature which sprung up on the eve of great reforms, and which denounced the bribe-takers and government thieves in prose and poems, in small stories and in large novels. The most talented among such writers was undoubtedly Michail E. Saltykov (1826-89). His early 'Provincial Sketches' at once placed him in the front rank of Russian literary men. To the end of his days Saltykov continued to denounce the corruption and abuses of the Russian bureaucracy, which did not fail to bring down on him the wrath of the government. His 'Well Meaning Discourses,' 'Messieurs Golovlevs,' 'Pompadours, Male and Female,' and 'Memoirs of a Provincial in St. Petersburg' are the best of his voluminous works. Around Saltykov we see other young writers of the same tendencies, such as Pomialovsky (1835-63), Reshetnikov (1841-71), whose novel 'Podlipovtzy' is often quoted, Levitov (1842-77), and inimitable Gleb Uspensky (1840 or 1843, died a few years ago). Our poets of the second part of the nineteenth century were, so to speak, brought up upon the poetry of Pushkin and Lermontov, but their poetry is much nearer to the reality. Of them deserving note are Maikov (1821-97), Polonsky (1819-98), Shenshin (pseud. Fet) (1820-92), Tutchev (1803-73), May (1822-62) and Count Alexis Tolstoi, the latter besides his many songs and poems, wrote a remarkable historical novel, 'Prince Serebrianniy,' and three trilogies, 'Death of Ivan the Terrible,' 'Czar Feodor Ioannovitch,' and 'Czar Boris.' The epoch of great reforms produced the division of our fiction writers into two classes: conservative and liberal. To the former, who, disappointed in the liberal movement and its leaders and influenced by the Polish insurrection, commenced a crusade against the liberal movement, belong Leskov, Kliushnikov, Markevitch, and Krestovskii, whose writings, not even always talented, have the stamp of having come out from a detective bureau, because they excited suspicion

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in treason and contained libels even against persons occupying high official positions, accusing them of being nihilists and anarchists. To the liberal class belong Terpigorev (1841-95), Garshin (1855-88), whose untimely death deprived Russian literature of one of the most talented writers. Another name which occupies an honorary place in Russian literature is that of Nicolai Tchernyshevski (1828-1903), who is best known by his novel 'What is to be Done,' which at the time produced quite a sensation among the young Russia, being a sermon of communism, though it did not disclose anything new to the readers of Eugene Sue's novels, containing similar Utopias. He wrote a good deal on politico-economical questions, but these articles lost all their interest and grew old; and his notes on Mill's 'Political Economy,' which represent the system of Louis Blanc, will also appear childish from the point of view of modern socialism. Among the contemporary writers there is quite a number of talented followers of the humanitarian school, men who represent the best element of the Russian intelligent society. Of the writers of fiction Albov, Zasodimski, Ertel, Korolenko, Zlatovratski, Maria Krestovskaja, Mamin-Sibiriak, Salov, and Lugovoi are the most popular and the most sympathetic. The most talented writer, who is called Russian Maupassant, Anton Tchekhov, died on 15 July 1904. His best works are 'My Life' and 'Peasants.' The names of Maxim Gorki and Leonid Andreev are those the most quoted at the present time. Maxim Gorki, undoubtedly a talented writer, uses his talent in depicting the life of the dregs of human society, vagrants, thieves, and inhabitants of the dens of vice and, strange to say, has the tendency to idealize his heroes. The most powerful of his novels is 'Foma Gordeev,' the only one which probably will survive him. As to Leonid Andreev, his popularity is purely the result of the unbounded—sickening at times—naturalism of his stories. Of contemporary poets the following are of note: Nadson (1862-87), a very talented poet, yet his poetry is too pessimistic to please all. Jemtchujnikov, Korinsky, Slutchevski, and especially Miss Stchepkina-Kupernik. One of the grand dukes, Konstantin Konstantinovich, who writes under the pseudonym 'K. R.,' is a poet of no mean degree. Among the followers of decadent school of poets are Merejkovski, Balmont, and Minski, but their poems, like those of Frug and Fofanov, serve mostly as subjects for comical reviews by our well known critic Burenin. Of the dramatists the best known are Potekhin, Krylov, and Shpajinski. Consult: Belinski, 'Russian Literature'; Polevoy, 'History of Russian Literature'; Sementkovski, 'Russian Literature on the Eve of the Twentieth Century'; Soloviev, 'Literary Movement of the Nineteenth Century in Russia.'

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Russian Thistle, a naturalized annual (*Salsola tragus*) (one of the *Chenopodiaceae*), becoming a dreaded pest in the northern and western United States. It is closely related to, and resembles, the prickly salt wort of the sea-beaches and in no way, except spinniness, can be confounded with the true thistles. It is a glabrous, succulent, spreading bushy herb, with slender branches and small linear leaves, tipped

by a prickle, and usually bright red at maturity. Its small flowers are single in the axils, and are succeeded by hard little fruits surrounded by broad, five-parted horizontal wing of the calyx, which is conspicuously veined. Like many desert plants, at maturity, and in the dry season, its branches contract into a ball, enclosing its capsules full of ripe seeds, and it becomes a "tumble-weed," blown across the country by the wind, and scattering its seeds, to take root in favorable soils. Careful cultivation is the best way to exterminate the Russian thistle.

Russ'niaks. See RUTHENIANS.

Rust, peroxide of iron, formed by the gradual oxidation of iron when exposed to the air. To remove rust the usual mode is to rub the object with a piece of oiled rag or emery paper. More rapid and more satisfactory results are secured by using very pure petroleum, and wiping with a hempen or woollen rag. To prevent rust, dip iron or steel articles in a mixture of equal parts of carbolic acid and olive-oil, rubbing the surface with a rag. Others rub the metal with a mercurial ointment, leaving a thin layer over the entire surface. If iron be dipped in a solution of carbonate of potash or soda in water the surface will be protected against rust for a long time, and objects can be protected for any period by burying in quicklime. Rubbing the surface with plumbago has a similar effect.

Rustchuk, roos-chook', Bulgaria, a town on the right bank of the Danube, at the confluence of the Lom, opposite Giurgevo, 42 miles southwest of Bucharest. It has some woollen, silk, and other manufactures, and considerable trade. It is of strategic importance owing to its position on the Turkish frontier, and was almost destroyed by the Russian bombardment in the war of 1877-8.

Rusts. See FUNGI.

Rutaba'ga. See TURNIP.

Rutaceae, roo-tá'sē-ē, a widely dispersed order of polypetalous plants with about 880 species, most frequent in warm regions, and especially so in South Africa and Australia. They are generally shrubs or trees, bearing leaves in various forms, without stipules, dotted with glands and often heavy-scented. The four- or five-merous flowers are often in axillary cymes, and the fruits are various, being most conspicuous in the genus *Citrus*, which produces the orange and lemon. Two American genera are the *Ptelea* (hop-tree), and the *Xanthoxylum*, or prickly ashes. The latter is represented by small trees, prickly, with a powerfully stimulative and tonic bark. The common rue is a member of the typical genus *Ruta*.

Rutgers, rüt'gérz, Henry, American philanthropist: b. New York 7 Oct. 1745; d. there 17 Feb. 1830. He was graduated from Columbia in 1766; served as captain and later as colonel of New York militia in the Revolutionary War, and entered the legislature in 1784 to which he was frequently re-elected. He was a member of the board of regents of New York University from 1802 to 1826. His gifts to public purposes were many, the chief being \$5,000 to Queen's

RUTGERS COLLEGE — RUTHENIUM

College of New Jersey, which thereupon took the name of Rutgers.

Rutgers College, located at New Brunswick, N. J. It was chartered in 1766 under the name of Queen's College, and the charter slightly altered in 1770. In 1771 the college was located at New Brunswick; during the Revolutionary War, when the British army occupied New Brunswick, the college exercises were continued at Millstone and at North Branch. The present site of the college was secured in 1808, and in 1825 a generous donation was received from Col. Henry Rutgers, and the name changed to Rutgers College in his honor. A theological school was at first affiliated with the college, but has since become an independent institution. There is a preparatory school established at the same time with the college. The organization of the collegiate department now includes two schools, the classical school and the Rutgers Scientific School. In 1864, the Legislature designated "The trustees of Rutgers College in New Jersey maintaining the Rutgers Scientific School" as the State College of Agriculture and Mechanic Arts; the Scientific School thus became the beneficiary of the Congressional land grant of 1862, and of the appropriation law of 1890. In the classical school the work of the freshman and sophomore years is required, two courses are elective for junior and senior years; the degrees of A.B. and B.L. are conferred. In the Scientific School the studies of the freshman year are the same for all courses, at the end of that year the student elects one of the six courses offered, certain subjects, such as English, history, political economy, etc., being required in all. The six courses are agriculture, civil engineering, and mechanics, chemistry, electricity, biology, clay-working and ceramics. All courses lead to the degree of B.S. There is also a special two years' course in ceramics. Military drill is required of all students in the Scientific School. The school conducts a university extension department, and the State agricultural experiment station is connected with it. The Scientific School is under control of the college board of trustees of which the governor, the chief justice, and the attorney-general are members *ex officio*; and is also under the supervision of a State board of visitors appointed by the governor. The college farm contains 100 acres and is well equipped with modern apparatus. The buildings on the campus include Queen's College, Fine Arts Building, Van Nest Hall, Geological Hall, Kirkpatrick Chapel and Library, State Laboratory, Ceramics Building, Winants Hall (dormitory) and the Ballantine Gymnasium. The library in 1910 contained 62,000 volumes; the students in the collegiate department numbered 420 and the faculty 46.

Rutgers Scientific School, a department of Rutgers College, New Brunswick, N. J., designated by law as the New Jersey State College of Agriculture and Mechanic Arts. See **RUTGERS COLLEGE**.

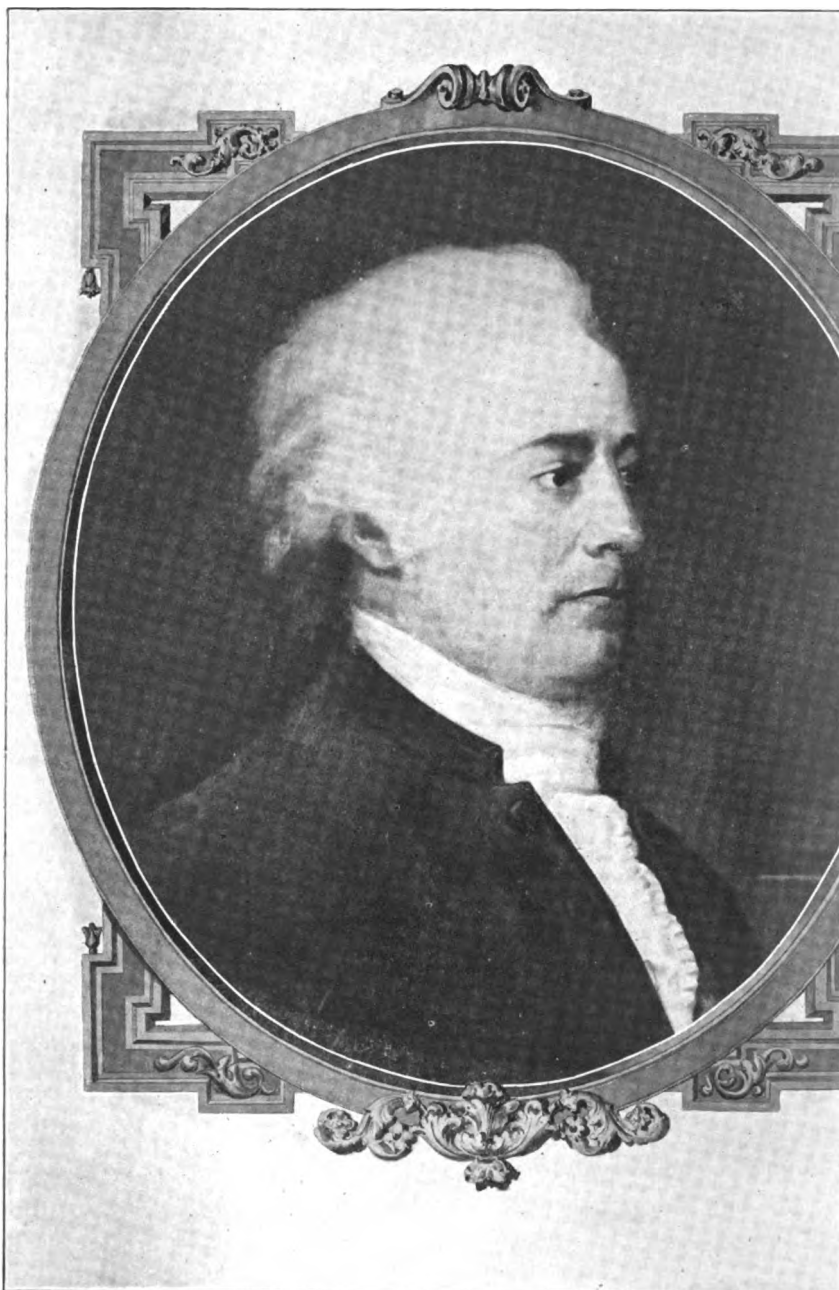
Ruth, Book of, a canonical book of the Old Testament, containing four chapters. The date of the little history contained in this book cannot be precisely fixed. Who the writer of the book was is also unknown. Some have ascribed it to Samuel; others have placed it as

late as the Babylonish captivity; whilst several of the best modern scholars regard it as post-exilic. On the one hand, the style of the narrative connects it with the period when the Hebrew language and literature were still in full vigor and freshness, not with the period of their decay. On the other hand, it is evident that it cannot be placed earlier than the time of the kings, first, from the way in which the judges are mentioned in chap. i.; secondly, from the change in the customs of the people that must have taken place between the date of the events and that of the narrative that records them (chap. iv. 7); and thirdly, from the mention of the name of David. In the Hebrew Bible the Book of Ruth now stands among the Hagiographa immediately after the Song of Solomon as one of the five Megilloth, or sacred rolls, read on occasion of the principal Jewish solemnities. But there can be no doubt that originally in the Hebrew Scriptures, as in the Septuagint and in the English Bible, it followed the Book of Judges, and was sometimes even reckoned part of it.

The story told in the Book of Ruth is a charming epic, relating the love of Ruth, a young widow of the tribe of Moabites, for Naomi, the mother of her dead husband. Ruth and her mother-in-law were very poor, and Ruth gleaned in the fields of Boaz, a rich husbandman of Bethel. Boaz, upon noticing the lovely Jewess, directed his harvesters to leave a generous supply of grain on the ground, thus enabling Ruth to glean a plenty. Subsequently Ruth married Boaz; she was the great-grandmother of David. Consult 'Popular Introduction to the Book of Ruth,' by R. W. Bush (London, 1883).

Ruthe'nians, Russniaks, or Red Russians, are the Slavonic tribes inhabiting eastern Galicia, Bukowina, and northeastern Hungary. The number of Ruthenians in the Austrian Empire amounts to 3,000,000, of whom about 500,000 are settled in Hungary. Very few can read or write. Their dwellings are wretched huts of boards and mud. Superstition is very rife. In the popular songs, which have a close connection with those of the other Slavonic nations, there is a prevalent strain of sadness both in the words and in the melodies. The occupations of the people are pasturage, agriculture, and carrying (by means of conveyances drawn by animals). Of manufacturing industry there is no trace. The towns are inhabited by Poles and Jews; the nobility are Polonized. The Ruthenians belong for the most part to the United Greek Church, and pay a blind obedience to their clergy. They are bitterly hostile to the Poles, and latterly their efforts have been directed to the separation of Galicia into a Polish kingdom in the west and a Ruthenian in the east. They have likewise begun to attach themselves in their literature to Russia, allowing the Ruthenian dialect to drop out of existence as a literary tongue.

Ruthe'nium, a metal of the platinum group. It has the atomic weight 101.7, and the symbol Ru. Some specimens of platinum ore contain from 3 to 6 per cent of ruthenium. It is a whitish-gray metal, having a specific gravity of 11 to 11.4; is very infusible, more so than any other metal except osmium; is



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CHIEF JUSTICE OF THE UNITED STATES SUPREME COURT, 1795.

scarcely attacked by nitromuriatic acid, but is more easily oxidized by fusion with nitre, chlorate of potassium, etc., than platinum. Ruthenium forms a series of salts which are analogous to those of platinum.

Rutherford, N. J., borough in Bergen County; on the Erie railroad; about nine miles from New York, seven miles southeast of Paterson, and eight miles north of Jersey City. It is a residential place, occupied chiefly by business men from New York. Several electric lines connect the borough with many of the cities and boroughs in the vicinity. Its principal public buildings are churches, schools, and a public library. Pop. (1890) 2,293; (1900) 4,411; (1910) 7,045.

Rutherford, Ernest, Canadian physicist: b. Nelson, New Zealand, in 1871. He was educated at Nelson College and the University of New Zealand, and at Trinity College, Cambridge, England. He was awarded the 1851 Exhibition Science Scholarship in 1895 and from that time until 1898 worked at research in the Cavendish Laboratory, Cambridge, in the latter year being appointed professor of physics in McGill University, Montreal. In 1903 he was elected a Fellow of the Royal Society; in 1904 delivered the Bakerian lecture before the Royal Society and was awarded the Rumford Medal; in 1905 delivered the Silliman lectures at Yale University. He is the author of numerous papers on the conduction of electricity through gases and on radioactivity, and also published 'Radioactivity' (Cambridge University Press 1904).

Rutherford, rŭth'ér-férđ, Lewis Morris, American astronomer: b. Morrisania, N. Y., 25 Nov. 1816; d. Tranquility, N. J., 30 May 1892. He was graduated from Williams College in 1834, admitted to the bar in 1837, and practised law in New York until 1849. He then devoted himself to the study of science, making valuable investigations in the departments of astronomical photography and spectral analysis. He made several instruments for use in his laboratory, among which were an object glass, a micrometer for measuring astronomical photographs and a dividing engine (q.v.) of great value. He was a trustee of Columbia University from 1858-84, when he resigned and presented his astronomical instruments to that institution where they are now mounted, and was also one of the original members of the Academy of Science.

Ruthven, rŭth'vën (Scotch, rŭv'ën), **Raid of**, one of the strangest conspiracies in British history, and even as yet unexplained, in which an attempt was made on the life of James VI., then king of Scotland, and afterward, as James I., king of England, after being decoyed to Gowrie House, at Perth, in the month of August, 1600, by Alexander Ruthven, brother of the Earl of Gowrie. See GOWRIE CONSPIRACY.

Rutland, Vt., city, county-seat of Rutland County; on the Otter and East creeks, and on the Rutland, B. & R., and the Delaware & H. R.R.'s; about 56 miles south-southwest of Montpelier, the State capital, and about 62 miles south by east of Burlington. It was settled in 1770 by persons from the East and was incorporated in 1761, by New Hampshire. It was chartered as a city in 1892. Rutland was

in the battle region of the War of the Revolution. Two forts were erected here, as it was situated on the Great Northern Military Road. In 1781 it was made the capital of the county, and from 1784 to 1804 it was one of the State capitals. The old boundaries included an area of 26,000 acres with the Green Mountains on the east and the Taconic Range on the west. In 1886 the towns of Proctor and West Rutland were set off from Rutland. The area of the city (1903) is 8¼ square miles. The new towns have independent governments, but all are united commercially. Rutland is in an agricultural region, but is well-known for its extensive marble quarries and industries connected with the shipment of marble. Iron ore, fire-clay, and slate are found in the vicinity. The marble works have been of considerable importance since 1830. The quarries are now in the new towns, but the industries continue as formerly. The chief industrial establishments of Rutland are manufacturing in which are made machinery for quarrying, and channeling marble, machine shops, engine and boiler works, Howe's scale factory, sash, door, and blind factories, butter and cheese factory machinery, lumber and brick yards, sugar evaporator works, creameries, and flour and grist mills. The government census of 1900 gives the number of manufacturing establishments 186; the amount of capital invested, \$2,112,530; number of wage-earners in manufacturing, 1,791; annual amount of wages, \$773,304; value of product, \$2,456,677. The principal buildings are Memorial Hall, built in honor of the soldiers of Rutland who fell in the Civil War, Baxter Memorial Hall, the government building, the county court-house, city-hall, house of correction, opera house, bank buildings, churches, and schools. The material for the construction of Memorial Hall was donated by the marble quarry companies and the cost additional was \$60,000. The educational institutions are a high school, Saint Joseph's Academy, public and parish graded schools, the Rutland Free Library, and Baxter Memorial Library. The city is well equipped with banks, newspapers, and wholesale and retail business establishments. Pop. (1890) Rutland 11,760; West Rutland, 3,680; Proctor, 1,758; total, 17,198; Rutland (1900) 11,499; (1910) 13,546. Consult: Hemmingway, 'Gazetteer of Vermont'; Moore, 'Churches of Rutland, Vermont.'

Rutledge, rŭtl'ēj, Edward, American soldier and legislator: b. Charleston, S. C., 23 Nov. 1749; d. there 23 Jan. 1800. He was admitted to the bar in 1773, established a practice in Charleston and in 1774 was elected to the Continental Congress. He was a signer of the Declaration of Independence in 1776 and a member of the first board of war. In this capacity he was delegated with John Adams and Benjamin Franklin to confer with Lord Howe on the subject of a reconciliation, but declined to treat with him excepting on the basis of American independence. As lieutenant-colonel of the Charleston artillery he assisted in expelling the British from Port Royal in 1779 and in 1780 was captured. After his release a year later he resided in Philadelphia, was a member of the Jacksonborough legislature in 1782, and after the war returned to Charleston where he resumed his law practice. He was for many years

a member of the State legislature, was elected United States Senator in 1794, and governor of South Carolina in 1798. Consult McCrady, 'South Carolina in the Revolution' (1901-2).

Rutledge, John, American jurist; brother of Edward Rutledge (q.v.): b. Charleston, S. C., 1739; d. there 23 July 1800. He studied law in England, returned to Charleston in 1761, and there established himself in law practice. From the outset of his career he was an ardent opponent of the oppressive laws governing the colonies and as delegate to the congress at New York in 1765 openly advocated the united resistance of the colonies. In 1774 he was a member of the South Carolina convention which carried a resolution that South Carolina should be represented in the Continental Congress. He served as delegate to the Congress of 1775 and in 1776 was chairman of the committee that framed the South Carolina constitution, was elected president of the State government and commander-in-chief of the militia. When the British forces arrived off Cape Fear he fortified Charleston and prevented the invasion of the State. He resigned his office in 1778 through dissatisfaction with changes in the constitution, but was recalled in the following year and invested with dictatorial authority. He at once set about preparations for defense and held the city until 1780. He then joined the forces of General Greene and upon the recapture of Charleston resumed his duties as governor. In 1782 he was elected to the Continental Congress, was re-elected in 1783 and in 1784 became chancellor of South Carolina. He was a member of the convention which framed the Constitution of the United States in 1787. He became chief justice of his State in 1791, and in 1795 was appointed chief justice of the Supreme Court. His mind failed in the following year and he held no further public office.

Ruwenzori, roo-wën-zō'rë, a group of mountains in Africa, north of the equator, discovered by Stanley in 1888, in his great journey from the west to the east coast, when he brought Emin Pasha away with him. It appears to be a chain of heights about 16,000 feet in elevation, and is clad with snow and traversed by large glaciers. It lies about 200 miles to the westward of the Victoria Nyanza, and between the Albert Nyanza and Albert Edward Nyanza. The river Semliki, which connects the two lakes, flows in a valley near the range. The snow-line is about 13,000 feet above sea-level. These mountains are sometimes identified with the Mountains of the Moon, spoken of by ancient writers.

Ruysbroeck, rois'brëk, or **Rusbroek**, roos'brök, **Jean de**, Dutch mystic: b. Ruysbroeck 1293; d. Grönendal 1381. He was educated at Brussels and for 26 years was vicar of the church of St. Gudula there. In 1353 he renounced the secular priesthood and entered the Augustinian monastery of Grönendal, in the forest of Soigny, where he became prior, lived a contemplative life and wrote his mystical works. His four principal works are 'Die Zierde der geistlichen Hochzeit'; 'Der Spiegel der Seligkeit'; 'Von dem funkelnden Stein'; and 'Samuel.' They were originally written in Dutch and are regarded by his countrymen as

among the best prose of the Netherlands during the Middle Ages. Translations were made into German, French and Latin. The four works cited were edited by Arnswaldt (1848); no collected edition has been made embracing his other works, which however, are mainly restatements of the main features of the foregoing. Consult: Engelhardt, 'Richard von S. Victor und Johann Ruysbroek' (1838); Ullmann, 'Reformatoren vor der Reformation.'

Ruysbroek, Willem van (GUILLAUME DE RUBRUQUIS), Franciscan friar and traveler: b. Brabant about 1215; d. some time after 1293. He was sent by Louis IX. of France to Central Asia to bring about an alliance with Sartach, a supposed Christian prince of Kiptohak, then at war with the Saracens. In May 1253 he set out from Constantinople upon his mission with two other Franciscan friars and an interpreter; crossed the steppes, now a part of the Russian province of Ekaterinoslav, reached the banks of the Don, and, after many hardships, the camp of Sartach near the Volga: Refused permission to preach Christianity in Tartary, he made his way across the Caucasus into Armenia, Persia and Asia Minor, reaching Tripoli in Syria in August 1255. An account of the countries and peoples visited by these missionaries was written by Ruysbroek and sent to the French king. The best modern translation is that of Michel and Wright in Vol. IV of 'Receuil de Voyages et Mémoires de la Société de Géographie' (1839).

Ruysdael, Jacob van. See RUISDAEL.

Ruyter, ri'tër (Dutch, roi'tër), **Michael Adriaanzoon de**, Dutch admiral: b. Flushing 24 March 1607; d. Syracuse, Italy, 29 April 1676. He early entered the navy and rose from cabin-boy to captain (in 1635). In 1641 he was placed as rear-admiral in command of a fleet sent to the assistance of the Portuguese, who had thrown off the yoke of Spain, and he was afterward employed against the Barbary corsairs. In the war between the Dutch and English, which commenced in 1652, Ruyter repeatedly distinguished himself, especially in the battle fought in February 1653, near the mouth of the Channel, in which Blake, commanding the English, defeated Tromp and Ruyter, who commanded the Dutch. He became vice-admiral of Holland after the death of Tromp in 1653 and afterward served against the Portuguese, the Swedes, and the Algerines. He commanded in the great battle fought in the Downs in June 1666, against Prince Rupert and the Duke of Albemarle, and in the following year made his memorable expedition up the Thames, when he destroyed Upnor Castle and burned some ships at Sheerness. He was made admiral-in-chief of the Dutch fleet and commanded at the battle of Solebay (Southwold Bay) in 1672, when the Dutch were defeated by the English under the Duke of York; but in the following year gained a victory over the combined English and French fleets. Consult 'Life' by Milne (1897).

Ryan, ri'an, Abram Joseph, American poet and Roman Catholic clergyman: b. Norfolk, Va., 15 Aug. 1839; d. Louisville, Ky., 22 April 1886. He became a chaplain in the Confederate army shortly after his ordination to the priesthood, and served until the close of the war, afterward engaging in clerical labors in New Or-



MOST REVEREND PATRICK JOHN RYAN.

ARCHBISHOP OF PHILADELPHIA.

RYAN — RYBINSK

leans, where he edited the 'Star.' He subsequently removed to Knoxville, Tenn., and thence to Augusta, Ga., where he established the 'Banner of the South.' He was later in charge of a parish in Mobile, Ala., but in 1880 went North where he engaged in lecturing and also supervised the publication of his poems, subsequently returning to the South. His works include 'The Conquered Banner and other Poems' (1880); 'Poems' (1880); etc.

Ryan, Edward George, Chief Justice for more than six years of the Supreme Court of the State of Wisconsin: b. Newcastle House, near the village of Enfield, County Meath, Ireland, 13 Nov. 1810. His father, Edward, was a younger son of the family of Ryan, of Ballinakill; his mother, Abby, was the eldest daughter of John Keogh, chairman of the Catholic Committee of Mount Jerome. By means of an annuity, obtained from this Keogh, the ten children of Edward and Abby received an excellent education. Edward George was sent to Clongowes Wood College, where he remained from 1820 until 1827. He was always destined for the law and was nominally engaged in its pursuit in 1828 and 1829. Obtaining his father's consent, he removed to New York city in 1830, where he studied law, supporting himself by teaching. Admitted to practice in 1836, he removed in the same year to Chicago, Ill. In 1839 he became the editor, in that city, of a newspaper called the *Tribune*, Democratic in politics and closing its career in 1841. During a portion of this editorial period he was prosecuting attorney of Cook County. Mr. Ryan's health being poor in Chicago, he removed in 1842 to Racine, Wis., and in December 1848 to Milwaukee in the same State. While residing in Racine he was in 1846 a delegate to a convention at Madison, the capital of the then territory, which met to frame a State constitution. As chairman of the committee on banks and banking, and member of the committees on the judiciary and on education he wielded great influence in the deliberations of the convention. While the constitution which this convention framed was repudiated by the people, yet the reputation of Mr. Ryan as a lawyer and a publicist was established.

As a practitioner in Milwaukee he achieved great renown, especially in criminal causes. His most conspicuous effort was in 1853, when he was employed to assist the managers of the Assembly of Wisconsin in its impeachment before the State Senate of Levi Hubbell, Judge of the Second Judicial Circuit. This trial ran through many weeks and was characterized on Mr. Ryan's part by the most skilful treatment of witness and by the most powerful invective in denunciation of the defendant.

Although a Democrat of the States rights school, Mr. Ryan was always loyal to the Government of the United States. The "Ryan Address" issued by him in 1862 did much to uphold the hands of the Government in its struggle for existence.

On the 7th of June, 1874, Mr. Ryan stepped from active practice at the bar to the position of Chief Justice of the Supreme Court. This was by executive appointment. In April, 1875, he was elected by the people to the same office for a term to expire in January, 1882. He did

not survive to finish this term. He died in Madison on 19 Oct. 1880.

WILLIAM W. WIGHT.

Ryan, James, American Roman Catholic bishop: b. Thurles, County Tipperary, Ireland, 1848. He came to the United States when a child, studied for the priesthood at the seminaries of Saint Thomas and Saint Joseph, Bardstown, Ky., was professor at Saint Joseph's and after ordination served on the Kentucky mission for seven years. In 1878 he was appointed to a charge at Wataga, Ill., and afterward was for a time at Danville. He was rector of Ottawa from 1881-8, when he was consecrated bishop of Alton.

Ryan, Patrick John, American Roman Catholic prelate: b. Cloneyharp, Ireland, 20 Feb. 1831. He pursued his elementary studies at the Christian Brothers' school in Thurles and began his first classical course at Mr. Naughton's school in the parish of Rathmines. Determined to become a missionary in the United States, he entered Carlow College and after receiving sub-deaconship there, came to the diocese of Saint Louis, Mo. He was ordained to the priesthood in 1853, made rector of the cathedral and subsequently appointed pastor of the Church of Saint John the Evangelist and vicar-general of the Saint Louis diocese. In 1868 Father Ryan accompanied Archbishop Kenrick to Rome and while there preached a series of Lenten sermons that elicited great praise. On 14 April 1872, he was consecrated Titular Bishop of Tricomia and coadjutor to Archbishop Kenrick and on 11 Jan. 1894 was elevated to the titular archbishopric of Salamis, being transferred the same year to the archiepiscopal see of Philadelphia. In 1883 he was among the United States prelates chosen to visit Rome in the interest of the Catholic Church in America. He gave two annual inaugural addresses at the State University of Missouri, lectured twice before the representatives of the Missouri legislature and delivered discourses in nearly all the large cities of the United States, notable among these lectures being that on Modern Skepticism. He has published 'What Catholics Do Not Believe,' and 'The Causes of Modern Religious Skepticism.' In 1902 President Roosevelt appointed Archbishop Ryan a member of the Indian Commission and he is a member of the Executive Board of Catholic Indian Missions. The archdiocese of Philadelphia over which he now presides (1905) has a Catholic population of about 475,000; 503 priests; 234 churches; 115 parochial schools; 5 hospitals and 12 orphanages besides many benevolent and educational institutions.

Ryazan, rē-ä-zän'. See RIAZAN.

Rybinsk, rü'bënsk, or **Rubinsk**, Russia, in the government of Yaroslav, 52 miles northwest of Yaroslav, on the Volga, at the confluence of the Rybinsk. As the port of Saint Petersburg, it is one of the most important points of north central Russia. It became a centre of traffic when the three canal systems connecting Saint Petersburg with the Volga were opened. Its enormous business of transshipment and active trade in grain and hemp, during the season, increases the population by nearly 100,000 workers. Permanent pop. about 30,000.

RYDAL - RYE

Rydal, England, a picturesque village in the county of Westmoreland, two miles northwest of Ambleside. It is situated in a narrow gorge formed by the projection of two mountains near Rydal Lake. The lake, only half a mile in area, contains two beautiful islets, is encircled by meadows and dominated by rocky heights which add to the charm and calm beauty of the surroundings, so celebrated in English literature. Rydal Hall is a fine mansion in a park which contains many grand forest trees and a cascade immortalized in verse by Wordsworth, who lived for some years at Town End, near by, the residence also for a time of De Quincey.

Rydberg, rüd'bërg, **Abraham Victor**, Swedish writer: b. Jönköping 18 Dec. 1829; d. Stockholm 21 Sept. 1895. He studied at the University of Lund, and in 1855 entered journalism, contributing to the leading paper of Gothenburg. In 1868 he was sent to an assembly of the church where he was the champion of liberal ideas, and from 1870 to 1872 sat in the Riksdag. In 1882 he became professor of the history of civilization at Stockholm. He is the author of 'The Pirate of the Baltic' (1857); 'The Last of the Athenians' (1859), which has been translated into English, German, and Danish; 'The Doctrine of Christ According to the Bible' (1862); 'Magic of the Middle Ages' (1864); 'Romish Legends of the Apostles Peter and Paul' (1871); etc. His works include studies in æsthetics, philosophy and psychology, besides poetry and a translation of Goethe's 'Faust,' and he is regarded as one of the foremost Swedish men of letters.

Ryde, rid, England, a watering-place in the Isle of Wight, on the Spithead shore, seven miles east-northeast of Newport. It is regularly laid out on a sloping site, and is a picturesque, elegant, and well patronized summer-resort, having regular and frequent steamboat communication with Portsmouth, Portsea, Southsea, etc. Pop. about 13,000.

Rydellius, Andrew, Swedish prelate and scholar, b. Linköping, in 1671; d. 1738. He studied under John Bilberg, and became instructor of philosophy and theology at Lund, where later he was appointed bishop. In 1718 he published a 'Course of Philosophy'; his other works include 'Grammatista Philosophans'; 'Sententiæ Philosophiæ Fundamentales'; 'Orationes Academicæ.'

Ryder, ri'der, **Albert Pinkham**, American artist: b. New Bedford, Mass., 19 March 1847. He studied his profession under William E. Marshall and in the art schools of the National Academy of New York. He has made a specialty of pastoral landscape and has been styled 'the last of the Romanticists.'

Ryder, William Henry, American Universalist clergyman: b. Provincetown, Mass., 13 July 1822; d. Chicago, Ill., 8 March 1888. He engaged in preaching when but 19 and at 21 became pastor of the First Universalist Society in Concord, N. H. He afterward preached at Nashua for two years and then traveled in the Holy Land. In 1850 he accepted the pastorate of the Universalist Church at Roxbury, Mass., from which he resigned in 1860 to become pastor of Saint Paul's Church, Chicago. At his death he bequeathed more than half a million dollars

to various charitable, educational, and religious organizations without regard to any difference in creed.

Rydqvist, John Erik, Swedish author and critic, b. Gothenburg 20 Oct. 1800; d. 19 Dec. 1877. He abandoned trade in 1820 to study law and ancient languages, and in 1827 received a civil appointment in the central administration. He became known by his literary and critical works, joined the staff of the Royal Library at Stockholm, and in 1843 was appointed chief librarian. The same year he succeeded Berzelius as member of the Swedish Academy. Besides numerous translations of Greek and English works into Swedish, literary and critical essays published in various collections, notably in the 'Heimdal,' a critical review that he conducted from 1828 to 1832, his principal works include 'The Chief Literary Events of Past Ages' (1828); 'The Most Ancient Stage Works of the North' (1836); 'The Civil Service in Sweden' (1838); 'J. Olof Wallin' (1839), a biographical study; 'Travels in Germany, France and Italy' (1838); and 'The Laws of the Swedish Language' (2 vols. 1850-57), a philological work of great value.

Rye, N. Y., a town of Westchester County, on the New York, New Haven & Hartford R.R., eight miles northeast of New Rochelle. Rye was founded in 1660, and five years later was organized as a town of Connecticut, the border line not being settled until 1700. One of Rye's interesting features is the Jay homestead, where John Jay spent his youth. Port Chester, a manufacturing village is within the boundaries of Rye, and Rye Beach on Long Island Sound, with its picturesque colony of bungalows, cottages and shacks, is a favorite summer resort for bathing, boating and other recreations. Pop. (1910) 3,964.

Rye (*Secale cereale*), a plant of the grass family, and allied to wheat, which yields the fifth most important cereal crop in the United States. It is an erect hardy annual, with slender stiff culms from four to six feet high, flat leaves, and a terminal, compact, somewhat flattened, bearded spike from four to six inches long. The spikelets are usually two-flowered, sessile, compressed, alternate, convex on one side and flat on that next the rachis. The outer glume is keeled and often carries a short awn, while the flowering glume carries a long awn. Each floret has three stamens and two very short styles. The grain is oblong, furrowed on the inside, hairy at the apex and generally free from the flowering glume and palea. The plant is not found wild, but is believed to be indigenous to the country bordering the Black and the Caspian seas. The granules of rye-starch are larger than those of wheat or barley, some being .0016 of an inch in diameter. The form of the larger ones is that of a flattened disk with a depressed centre having cracks on its outer edge. The hilum is central with lines radiating almost to the circumference.

Rye is harder than wheat and is usually cultivated in cool regions on sandy or light soils, and in the Eastern States on medium loams which have become physically or chemically defective and will not produce satisfactory wheat crops. It will thrive on reclaimed peaty soils. In the rotation, rye occupies the same place that wheat would, and, like the latter, prefers a fine

RYE-GRASS — RYE-HOUSE PLOT

firm seed bed. For a grain crop, from $1\frac{1}{4}$ to 2 bushels per acre are usually sown in the autumn. Judicious rolling and harrowing in spring is often beneficial. The crop is harvested just before it is fully ripe, a good yield varying between 15 and 30 bushels of grain and from one to two tons of straw. The straw is particularly tough and pithy and of little feeding value. It takes a long time to rot in the manure heap when used as litter, unless it is chaffed.

Two types of rye are grown, the common or autumn-sown usually grown for grain, and the spring-sown usually sown in spring, but the former may be sown in spring and the latter in autumn. Midsummer or Saint John's Day rye and giant or Tyrolese rye are spring varieties and good for forage, the latter requiring a rich soil. When grown for forage, as a cover crop, or to be plowed in as green manure, three bushels of rye may be sown per acre at various seasons of the year, the only proviso being that there shall be sufficient moisture and warmth present to insure germination and growth. Green rye is an excellent feed, either for soiling or folding in the spring, being well suited for cows in milk or ewes with lambs. As soon as the ear appears the straw becomes tough and woody, so that stock refuse it, hence it should be grown in small areas and a succession put in. A bushel weighs about 56 pounds and each pound contains on an average about 21,000 kernels.

Feeding Value and Uses.—In northern Europe the grain is largely used for bread-making, but in this country it is chiefly employed either in the manufacture of malt and spirituous liquors, as rye whiskey, etc., or as food for stock. Holland's gin and the national Russian drink, kvass, are largely made from rye. The following table shows that rye does not differ materially from wheat in composition, nor are its by-products chemically dissimilar from those of the wheat grain:

Average percentage composition of	Water	Ash	Protein	Crude fibre	Nitrogen-free extract	Ether extract
Rye	11.6	1.9	10.6	1.7	72.5	1.7
Rye flour...	13.1	0.7	6.7	0.4	78.3	0.8
Rye bran...	11.6	3.6	14.7	3.5	63.8	2.8
Rye shorts...	9.3	5.9	18.0	5.1	59.9	2.8

The percentage digestibility of rye meal with ruminants is dry matter 87, protein 84, nitrogen-free extract 92, ether extract 64; while that of rye bran with pigs is dry matter 67, protein 66, nitrogen-free extract 75, ether extract 58.

In milling the outer portion of the rye kernel constitutes the bran, the second layer the "middlings" or "shorts," and the inner portion the flour. For stock the whole kernel is ground. Rye flour is somewhat similar to corn meal as a source of protein and energy, but is more expensive. Ground rye and rye bran are fed to cows in Denmark. Not more than 3 pounds daily should be given, as they are said to have a deleterious effect upon the quality of the butter. Experiments show that for pig feeding rye is of equal value with barley, and that one pound of rye is equal to six pounds of separated milk or twelve pounds of whey; that rye shorts are inferior to rye, the pork from the former being softer and showing more shrinkage. Ground rye

may be safely fed to work horses to the extent of 8 or 10 pounds daily, together with other feeds, as bran or oats. Owing to the hollow stems of rye holding considerable air, this crop is not making much progress for silage purposes.

Rye straw is longer and more uniform in size than that of other grains and when unbroken it is used for packing pottery, horse collars, mattresses, etc., and in the manufacture of a variety of articles, as paper, hats, bonnets, mats, slippers, toys and fancy articles. For such purposes, it often commands a good price.

Diseases.—Ergot (*Claviceps purpurea*) is the chief disease and is common on other graminæ. The elongated, curved, brownish or purplish spurs of ergot form on the head in place of a kernel and are sown with the seed unless it is carefully screened. If sown, they germinate and finally send out minute spores which, attaching themselves to the grass, live on it parasitically, send out small thread-like growths which finally reach the ovary, where they displace the rye grain and reproduce the cockscur or resting spore. Ergot should be removed before rye is used as feed, as it is dangerous to man and beast.

Statistics.—In 1902 the world's crop of rye was 1,678,714,000 bushels and the production of the United States, 33,630,592 bushels, both being the highest recorded. In 1902 the leading countries growing rye were Russia, 894,440,000 bushels; Germany, 373,768,000 bushels; Austro-Hungary, 140,476,000 bushels. The average yields per acre for the past eight years are Germany 22.6 bushels; Austro-Hungary 16.1 bushels; United States 15.0 bushels; Russia 11.6 bushels. In 1902 the average yield of the United States was 17 bushels per acre, valued at 50.8 cents per bushel, or \$8.63 per acre. In 1902 the leading States were Wisconsin and Pennsylvania, each producing over 6,000,000 bushels; Nebraska, 3,250,000 bushels; New York, Michigan and Minnesota with over 2,000,000 bushels.

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Rye-grass. See GRASSES OF THE UNITED STATES.

Rye-house Plot, in English history, a conspiracy which took place in the reign of Charles II., and which became famous from the fact that its detection involved the death of Lord William Russell, Lord Essex, and Algernon Sidney, who were in no way connected with it. The immediate object of the Rye-house Plot, which was contrived in 1683 among a number of obscure persons belonging to the party of which those celebrated men were among the leaders, was to assassinate the king and his brother, the Duke of York (afterward James II.), as they returned from the Newmarket races. This plan was to have been executed at a convenient spot on the road from Newmarket to London, where there was a farm called Rye-house, belonging to one of the conspirators name Rumboldt; but the plan was frustrated by the king and his brother happening to return from Newmarket earlier than was expected. Soon after information of the matter was laid before one of the secretaries of state, and it was added that since this plot had been frustrated the plan of a general insurrection had been taken up by various eminent persons, among whom were those mentioned.

A general insurrection had indeed been talked of among the accused persons, and the details and probable success of such a scheme appear to have been considered by them; but there was no evidence whatever to show that the promoters of the wider scheme were in any way involved in the minor plot, which was got up, after the general insurrection had first been talked of, by a few of those who were already concerned in the larger plan. Yet from the way in which the revelations were made to the government the two schemes were completely confounded, and Russell, Essex, and Sidney were arrested on the charge of treason. Essex put an end to his own life in the Tower, and Russell and Sidney were condemned and beheaded. Lieutenant-colonel Walcot, one of the real contrivers of the Ryehouse Plot, was at the same time brought to the block.

Ryerson, rî'ér-sôn, **Adolphus Egerton**, Canadian Methodist: b. Charlotteville 24 March 1803; d. Toronto 19 Feb. 1882. He entered the Methodist ministry in 1825; and became identified with the Methodist Episcopal Church of Canada at the organization of that body in 1828. In 1832 went to England to form a connection with the parent body. In 1842 he became first president of Victoria College and in 1845 was appointed superintendent of education for the province of Upper Canada, a position he retained for 30 years. Besides founding and editing 'The Christian Guardian,' he wrote 'A Manual of Agricultural Chemistry'; 'The Clergy Reserve Question'; 'Compulsory Education.' Consult: Egerton Ryerson, 'The Story of my Life' (1884).

Ryland, rî'land, **Henry**, English artist: b. Biggleswade, Bedfordshire. He was trained in art at the South Kensington schools and worked at Paris in the studio of Benjamin Constant, and at Julian's Academy under Boulanger and Lefebvre. His practical professional life was begun by him as a designer of stained glass and he contributed to the 'English Illustrated Magazine' in its early days. His first work as a painter was exhibited at the Grosvenor Gallery, but he has since exhibited, chiefly watercolors, at the other exhibitions of London, and many of his pictures have been engraved.

Ryle, ril, **John Charles**, English Anglican bishop: b. Macclesfield, Cheshire, 10 May 1816; d. Lowestoft, Suffolk, 10 June 1900. He was educated at Oxford, took orders in the English church, and was successively curate at Exbury, rector of St. Thomas', Winchester (1843), of Helmingham, Suffolk (1844), and vicar of Stradbroke, Suffolk (1861). He was appointed honorary canon of Norwich, in 1872, and in 1880 was nominated Dean of Salisbury, but before he

had taken possession of this post was made bishop of the newly formed see of Liverpool. He was one of the most prominent members of the Evangelical party, and besides publishing numberless tracts which were widely popular, was author of such books as 'Coming Events and Present Duties' (1867); 'Bishops and Clergy of Other Days' (1868); 'The Christian Leaders of the Last Century' (1869); 'Expository Thoughts on the Gospels' (1856-69).

Rymer, rî'mër, **Thomas**, English critic and antiquary: b. Yafforth, Yorkshire, 1641; d. London 14 Dec. 1713. He studied at Cambridge, subsequently kept terms at Gray's Inn, and was called to the bar in 1673. In 1678 he published 'Edgar, a Tragedy.' In 1692 he succeeded Shadwell as historiographer royal, and was entrusted with the preparation of a collection of public treaties, which he began to publish in 1704, under the title of 'Fœdera, Conventiones, et cujuscunque Generis Acta publica, inter Reges Angliæ et alios Principes.' Of this valuable and learned work he completed 15 volumes, and five more were afterward added by Robert Sander-son. The publication of the whole work was completed in 1735.

Rymer, **Thomas**, of Ercildoune. See RHYMER, THOMAS THE.

Ryotwar, rî'ôt-wâr, in India, the lease of land by the government officers to the ryots or native cultivators at a fixed rent, a practice chiefly prevalent in the Madras Presidency.

Rysbrack, rüs'bräk, **John Michael**, German sculptor: b. Antwerp 1693 or 1694; d. 8 Jan. 1770. He went to England in 1720 and made a reputation by the exercise of his art, of which Westminster Abbey and several cathedral churches contain examples, among which may be mentioned the monuments of Sir Isaac Newton and the Duke of Marlborough. He also executed the equestrian statue of William III., at Bristol, and the statue of Locke at Oxford.

Ryswick, riz'wîk (Rijswijk), Netherlands, a village between Delft and The Hague, famous for the celebrated treaty concluded in 1697, and known as the 'Peace of Ryswick,' signed by France, England, Spain, and Germany. It terminated a bloody war waged by England against France. Louis XIV. relinquished his recent conquests except Strasburg, which was taken in 1681. He also acknowledged William III. king of Great Britain and Ireland.

Rzheff, rzhëf, or Rjev, Russia, in the Tver government, occupies the heights on both banks of the Volga. It is a railway terminus, 89 miles southwest of Tver, and the centre of a great transit trade between the provinces of the lower Volga and the ports of Saint Petersburg and Riga.

S

S the nineteenth letter and fifteenth consonant of the English and several other alphabets, is classed as a sibilant or hissing letter. The sibilant is of two kinds, one produced merely by emission of the breath while the end of the tongue is brought close to the front palate just behind the gums: this is the hard open sound; the corresponding soft open sound is represented in the alphabet by *z*, but in practice is often represented by *s*. The form *S* is the ancient Greek character *ς* with its angles rounded: in the existing Greek alphabet the *s* is represented by *Σ*. In some English words *s* is silent: island, aisle. The final *th* of verbs has changed to *s* because of the nearness of sound of *s* to *th*: loveth, loves; hath, has. There are several words in English—and the like can be said of Greek—which, beginning with *m* or *p* or *l*, take on an initial *s*; melt, smelt; pike, spike; lick, slick; Gr. mikros, smikros: compare Ger. niesen, Eng. sneeze. Sometimes the sound of *s* is changed to that of *st*: the verb hoise becomes hoist, whiles becomes whilst; and there is the mispronunciation of once, onst; and the plural of mouse is mice. The digraph *sh* stands usually for the ancient *sc* (*sk*): Old Eng. sceal, shall, fisk, fish.

S. P. Q. R., the initial letters of *Senatus Populusque Romanus* (the Senate and the Roman people), which was supposed to express the political character of the Latin nation. These initials were carried as a battle standard by the Roman armies.

Sa de Miranda, Francisco de, frân-thês'kô dâ sâ dâ mē-rân'dâ, Portuguese poet: b. Coimbra, Portugal, 27 Oct. 1495; d. there 15 March 1558. He wrote much in Spanish, taking for his models Dante and Petrarch, but in sentiment remained entirely loyal to his native country. His fame rests chiefly upon his poetical epistles and eclogues, though his entire work is excellent, and characterized by sincerity and love of natural beauty. He is ranked as one of the six greatest Portuguese poets. An edition of his work edited by Carolina Michaëlis de Vasconcellos contains 189 of his pieces, 74 of which are in Castilian.

Saadja Gaon, sâ-äd'yâ gâ-ôn' (SAADJA BEN JOSEPH, Arab SAID), Jewish Rabbī: b. Fayum, the Biblical Pithom, Egypt, 892; d. Babylonia 941. In 828 he was appointed Gaon or principal of the Jewish Academy at Sura, near Babylon, into which dwindling institution his zeal and learning infused new blood. His acquirements were many and varied, and he lived in a time when philosophy and reason were in danger of usurping the authority hitherto wielded by tradition, and especially were the Karaites inclined to

discard the latter. It was the work of Saadja to discover a common ground for the maintenance and support of Jewish dogma side by side with philosophical theory. This was the object of his great work, written in Arabic, 'Emunot w'deot' ('Faith and Ethics') which was translated into Hebrew by Juda ibn Tibbon (1160) and into German by Fürst (1845). Saadja wrote a commentary to some of the books of the Old Testament, treatises on grammar, and hymns for the synagogue. On the 1000th anniversary of his birth a complete edition of his works was published by Joseph Derenbourg. Consult Grätz, 'Geschichte der Juden' (1870); Guttman, 'Die Religionsphilosophie des Saadja' (1882).

Saale, zä'lě, Germany, the name of several rivers, flowing between Baireuth and Hof, in the northeast of Bavaria. The most important of these is the river rising in the north side of the Fichtelgebirge at an altitude of 2,390 feet. It is navigable from Naumberg and passes Kahla, Jena, Kainburg—it becomes very circuitous, passing Merseburg and Halle, and finally connects with the Elbe, near Leipsic, by canal. It flows through a fertile and picturesque valley for 200 miles, its romantic heights crowned by many castles. It is of great commercial value, having a wide and deep channel in the greater part of its length.

Saarbrücken, zär'brük-ën, or **Sankt-Johann Saarbrücken**, Germany, in the Rhine province, Prussia, is situated on the Saar, 39 miles southeast of Treves. Its sister-town across the river gives the town the double name. It is an important industrial centre, is well-built, and has a castle. There is a mining academy and a monument to Bismarck. The principal industries are wool-spinning, brewing, and the manufacture of tobacco, chemicals, tin, and stoneware. Trade is mainly dependent on the coal mines, the glass and iron works of the district. In 1870 the French and Prussian forces fought here the first engagement of the Franco-German war resulting in a partial victory to the French, which the Germans retrieved four days later by their first victory in the vicinity. Pop., including Sankt-Johann about 47,000.

Saba, sâ'ba, one of the Leeward Islands, Dutch West Indies, area five square miles. It is high and rocky, rising abruptly from the sea to a height of nearly 3,000 feet. A small proportion of the area is under cultivation; the chief products are tropical fruits and vegetables, especially cabbages, and cotton. Fishing is also an important industry, and fishing boats are built on the island. The inhabitants are the descendants of Dutch and Scandinavian pirates who occupied the island in the 17th century. The

SABADILLA — SABATIER

island nominally belongs to Holland, but the people are practically independent, being exempt from taxes and electing their own governor. Pop. about 3,000.

Sabadilla, or **Cevadilla**, the pharmaceutical term for seeds of a liliaceous plant (*Schænocaulon officinale*), growing in Central America, with a bulbous root, grass-like leaves and a flower-stalk some six feet in height. The papery, tri-capsular fruits contain a few pointed, wrinkled, blackish seeds, persistently acrid and sternutatory, a powerful irritant and poisonous. They are employed for preparing veratrine, which in the form of a tincture or ointment, is used as an external application for neuralgia and rheumatism, but is likely to prove poisonous if the skin be broken, thus permitting absorption. Sabadilla has also been given as a dangerous vermifuge, and is used for killing vermin.

Sabæaniam, sā-bē'an-izm, or **Sabianism**, a religion whose believers were once numerous in Arabia, Syria and Mesopotamia, which while it recognized only one supreme being, also worshipped, or paid high reverence to angels, or inferior divinities, supposed to reside in the stars. This part of the Sabæan creed virtually amounted in practice to star-worship.

Sabæans, sā-bē'an-z, the ancient name of the inhabitants of the modern Yemen, in Arabia. Ptolemy places them in the north and middle of what is now called Yemen, and earlier geographers to the south of that province; but the fact appears to be that they were a race dwelling on both sides of the Red Sea on its southern shores, in Arabia and Ethiopia. The names applied to the peoples dwelling on the different sides of the Red Sea were very like, Shebaim being that of the Arabian section, and Sebaim that of the Ethiopian. The country of the Shebaim was probably the Sheba of the Bible, the land of the queen who came to visit Solomon. It was fertile and rich in spices and perfumes, and carried on an extensive trade with the East.

Sab'aism, the name derived from Hebrew and Arabic, given to the worship of the stars as deities. It extended through the countries of the Assyrian and Medo-Persian empires as far as Asia Minor, between the Caspian Sea, the Euxine, and the Mediterranean, from the Armenian Mountains as far as the banks of the Nile and southern Arabia; but it assumed different forms in different countries, appearing sometimes more sensual, sometimes more spiritual. The objects of worship were the sun, the moon, and the planets, or rather the planetary spirits of which the planets were believed to be the frame or the body. The worship of the sun was especially cultivated in Babylon and Phœnicia. The worshippers of the stars generally ascribed to them a great influence upon and a knowledge of terrestrial affairs; and astrology, the casting of nativities, and various systems of demonology, were therefore the natural result of Sab'aism. The astrological system was most largely developed by the Egyptians, while Parseeism was the purest and most perfect form of Sab'aism. In the Koran the star worship of ancient Arabia is designated by the name Sab'aism. In the town of Haran, in Mesopotamia, a kind of Sab'aism maintained itself, surrounded on all sides by Christianity, until the Middle Ages. One sect of Sabæans believed in the migration of the

soul, and in great world-periods, constantly renewed in an everlasting revolution, a view sustained to a certain extent by modern philosophy.

Sa'bal, or **Cabbage Palmetto**, the most northern arborescent palm in the world. It is a tree attaining 80 feet in height. Until it is from 10 to 20 feet high, its straight, robust stem is surrounded by the dry fibrous sheaths, and the stubs of petioles, of leaves, projecting like spines, and giving a very picturesque and characteristic appearance. The leaves, massed at the top of the trunk are cordate, or fan-shaped, narrowly pinnatifid, each division cleft at its apex and recurved at the summit. The terminal bud, by which growth is continued, or "cabbage," is a favorite delicacy with the negroes, who cut it out of the young and healthy trees,—thereby causing the ultimate death of the palmetto—and cook it as a vegetable. Many palmettoes are killed by the removal of the tops of the young trees. These tops are sent to factories, where they are trimmed down to a disk some eight inches thick, the soft central parts are cut out, and the disk is then boiled to loosen the fibres of the sheaths and petioles, which are made into scrubbing brushes. These buds for brushes are worth only about 6 or 7 cents apiece, and yet the trees are being exterminated for so slight returns. The mature leaves are used for thatching, and the trunks resist teredos to such an extent that they are valuable for sub-marine pilings.

This palmetto has always been interwoven with the history of South Carolina, the "Palmetto State." A fortification, or stockade, on Sullivan's Island in Charleston Harbor, 1776, was composed of earth and palmetto logs, and succeeded in repulsing the attacking British fleet under Sir Peter Parker, whose shot had practically no effect on the wall, for they could not split the spongy trunks, but were imbedded in them. Therefore, in memory of this event, the palmetto tree appeared on the seal of South Carolina, over an uprooted branchless oak-tree representing the oaken ships of England; on a flag adopted after the Ordinance of Secession (1861) was passed; and also on a medal. At the signing of the secession ordinance, palmetto trees flanked the platform, and at the back was the banner of the convention, bearing among other curious devices, a most unnatural palmetto, with a gigantic rattlesnake wound about its trunk. Cockades, rosettes of blue ribbon with a palmetto imprinted on a button in the centre, were worn by Charlestonians in 1860-1.

Sab'alo, a name of the tarpon (q.v.), further known as savalle, savanilla, grande ecaille, silver-king, etc.; also of the Hawaiian milk-fish (*Chanos chanos*).

Sabaoth, sā-bā'ōth, or sa-bā'ōth, **Lord God** of, a term used in the Scripture, meaning "Lord God of Hosts." It has no connection with the word Sabbath.

Sabatier, sā-bā-tē-ā, **Paul**, French theologian and historian; b. Saint-Michel-de-Chabrelanoux, Ardèche, 3 Aug. 1858. He was educated in the theological faculty of Paris, and in 1885 became vicar of the French parish of Saint Nicolas at Strasburg. The German government offered him a superior appointment, involving his becoming a German citizen; he requested to be allowed to retain his post as vicar, but the request was viewed as a political manifestation, and he was banished the coun-

try. For a brief time he was pastor of Saint Cierge la Serre; then he withdrew from the ministry to devote himself wholly to historical studies. His chief work is 'La Vie de Saint François d'Assise' (1893), based largely on previously unutilized documents discovered by him in various Italian archives. Within a year from the appearance of the first French edition, editions had appeared in almost all Continental languages, including Swedish and Polish. The Russian version was prepared under the direction of Tolstoi. Sabatier published also 'La Didaché ou l'Enseignement des Douze Apôtres' (1885), and editions of the 'Speculum Perfectionis' by Leo of Assisi (1898; translated into English by S. Evans as 'St. Francis of Assisi, the Mirror of Perfection' (1898), and of the 'Tractatus de Indulgentia' (1900), of Franciscus Bartholus. Consult article by Rawnsley in 'Contemporary Review', V. 74, pp. 505-18 (1898).

Sabazius, sa-bā'zhī-ūs, a Phrygian divinity, identified by the Greeks in part with Zeus and in part with Dionysus. His symbol was a serpent. His worship extended to Greece, and was found also in Italy, especially in late pagan times. He was said to have been the first to employ oxen for plowing.

Sabbatai Zevi, sabb-bā-tī' zē-vē', whose name is also spelled "Sabtai Zefi" and Sabbathais Zevi, a pretended Messiah: b. Smyrna 1641. He was a man of great learning and magnetic presence, and he led thousands of followers, mainly in Smyrna, Salonica, Alexandria, and Jerusalem, to believe in him as the Messiah. In 1664 he had about 80,000 followers; in the following year the beginning of the Messianic reign within a few months and the rebuilding of the Temple in the next year were proclaimed in the streets of Alexandria by Sabbatai and six disciples, clad in white raiments, with garlands on their heads. Having excited serious alarm at Constantinople, he was apprehended at Smyrna, and terrified into a recantation of his mission. He was said to have declared that his sole object had been to embrace Islam, and to carry over all the Jews with him. The sultan declared himself satisfied, and honored him with the title of an effendi, giving him an honorary post at the same time. He again aroused the jealousy of the Turks, and was either poisoned in prison, or publicly executed.

Sabbatarian Controversy, the dispute in various forms between those who urge and those who oppose a rigid observance of Sunday. It has been going on from the time of King James I., of England, who favored Sunday sports, and thereby offended many of his subjects, and it has in late years included proposals to throw open to the public museums, libraries, and galleries, and other places of recreation and instruction, on the first day of the week. Most of these changes have been generally adopted. The proposition to permit the sale of alcoholic liquors in saloons on Sunday is at present the chief feature of the Sabbatarian Controversy.

Sabbatarians, a term applied to those who urge rigid observance of Sunday. It was applied also in earlier times to the sect now known as Seventh Day Baptists, who observe Saturday for Sunday; and who, for that reason, are permitted in Rhode Island, where they are comparatively numerous, to work on Sunday.

Sabbath, the ancient Hebrews' weekly day of rest. In Hebrew the word means week, and the expression of Josephus (Apion ii. 2), who explains it as meaning "a rest from all labor," is rather to be looked upon as a commentary than as a derivation etymologically correct.

The Sabbath was the seventh day of the Hebrew week and lasted from sunset on Friday to sunset on Saturday. It was celebrated as a holy day; a day of rest and rejoicing; by ceasing from all labor, and by causing servants, strangers, and cattle to cease also. Plants even were to rest; they were neither to be sown nor reaped on that day. The services of priests and Levites in and about the tabernacle and temple were, however, to be performed through the Sabbath-day. Circumcision, too, could take place on the Sabbath, when it fell on the eighth day after the birth of a male child.

Profanation of the Sabbath was punished by stoning to death. It was not until after the exile that the character of the work by which the Sabbath could be profaned was strictly defined. In the law only one act of labor was specifically prohibited, that of lighting a fire for the purpose of cooking. According to Josephus armies never proceeded on their march on the Sabbath. The Pharisees forbade even the plucking of grains of corn on that day; the healing of a sick man; or the walking of a cured patient bearing his bed. According to the Mishna even a broken bone was not to be set, nor dislocations poulticed or bound up on that day.

Origin of the Sabbath.—The Sabbath appears to have been an institution of religion long prior to Moses. It is sometimes said that it was borrowed by him from older nations, such as the Egyptians. Such Latin writers as Seneca and Ovid give intimations that the veneration for the seventh day had found some favor among the early Romans. It seems more natural to suppose that it had come down with the old traditions of theocratic religion which are found embalmed in the first chapter of Genesis. The poem of the creation, in which God is related to have created the world in six days and rested on the seventh day, embodies a tradition much earlier than the period of Mosaic legislation. There are several intimations in the patriarchal age that the followers of Jehovah, such as Abraham and Isaac, chose certain times for rest, meditation, prayer and sacrifice to God. In after times it would almost seem as if the poem or hymn of the creation was used as a special part of Sabbath-day devotions. On that day the people were called to reflect upon the fact that the whole universe, including themselves, had an origin in one personal and supreme Being; that He had exerted His Omnipotence for a definite period and then had ceased from His work. They were constantly to remind themselves of the work of God, once for all completed, by their own six days' round of labor; and as God had rested from His work so were they to rest from theirs and to turn their thoughts toward Jehovah "who had done so great things for them."

Mosaic Ordinances of the Sabbath.—The scope and meaning of the Sabbath-day was very much extended and amplified by the provisions of the law as contained in the Hexateuch. It was made to be a day on which not only the finished task of creation was to be commemorated, but on which the great providential deliv-

SABBATH

erances of the children of Israel were likewise to be recalled. But first of all the command is given by the law in various forms of speech, but with the same intent throughout the books of the law, Exodus, Deuteronomy, and Leviticus, to remember the seventh day, the Sabbath, to keep it holy; most specifically in Lev. xxiii. 3: "Six days shall work be done: but the seventh day is the sabbath of rest, an holy convocation; ye shall do no work therein: it is the sabbath of the Lord in all your dwellings."

First of all there are three specifications as to the manner in which the week is to be spent: (1) by labor—"Six days shalt thou labor, and do all thy work:" (Ex. xx. 9); (2) by rest on the seventh day; on this day the people are ordered to rest, literally to take breath, then are enumerated in detail those who are enjoined from work: "Thou, nor thy son, nor thy daughter, thy manservant, nor thy maidservant, nor thy cattle, nor the stranger that is within thy gates." The penalty of death is threatened against all who shall disobey this command. The reasons of this command are given: (1) as a counsel of mercy—"Six days thou shalt do thy work, and on the seventh day thou shalt rest, that thine ox and thine ass may rest, and the son of thine handmaid, and the stranger, may be refreshed" (Ex. xxiii. 12); (2) as a commemoration of the deliverance from Egypt—"And remember thou wast a servant in the land of Egypt, and that the Lord thy God brought thee out thence through a mighty hand and by a stretched out arm, therefore the Lord thy God commanded thee to keep the sabbath day" (Deut. v. 15); (3) as a commemoration of the finished creation "For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested the seventh day: wherefore the Lord blessed the sabbath day, and hallowed it" (Ex. xx. 11); (4) as a sign of the covenant, just as circumcision was the sign of the Abrahamic covenant, and the rainbow the sign of the covenant with Noah—"Speak thou also unto the children of Israel saying, Verily my sabbaths ye shall keep, for it is a sign between me and you throughout your generations, that ye may know that I am the Lord that doth sanctify you. . . . It is a sign between me and the children of Israel for ever: for in six days the Lord made heaven and earth, and on the seventh day he rested, and was refreshed" (Ex. xxxi. 13, 17).

The Jews of to-day who profess to keep up the tradition of their fathers still keep the Sabbath as a joyful festival. The Sabbath is held from Friday evening to Saturday evening. It is among some of them considered a pious observance to begin the celebration half an hour before Friday's sunset and to continue it half an hour after sunset on Saturday for the benefit of the souls of those who are in torment, for they believe that the damned are allowed a mitigation of their suffering during the feast. On Friday afternoon all the food for the following day is prepared, and their festal array is laid out for the Sabbath. Some Jews have special raiment which they wear only on that day; on the morning of which the Sabbath lamp is lit and the Sabbath bread laid on the table. The master of the house at the close of the evening meal blesses the wine and passes it round. They eat three meals on the Sabbath-day and they

have a maxim that it is good to honor the day in the body, in dress, in eating, and in drinking.

The Lord's Day.—A careful consideration of early Church history and early Church writers leads to the conclusion that the day of Christ's resurrection, the first day of the week, grew up, coeval with the existence of Christianity itself, as the one distinctively Christian festival, which was made to fall in with the injunction to periodical rest, founded on the earliest traditions of biblical religion and provided for under Moses by special legislation for the observance of the Sabbath. Nevertheless the idea of the Lord's Day is wholly distinct from that of the Sabbath, which seems to have been likewise observed by the early Church, although sometimes as a fast. The Saturday half-holiday, which still survives in some countries or at some seasons of the year, is certainly derived from this double observance. The tendency to sabbatize the Lord's Day was perhaps due to certain imperial decrees of the Christian emperors beginning with Constantine, who closed the law courts, etc., on what Justin Martyr calls "the day of the sun," and what Constantine speaks of as "venerable Sunday."

Civil legislation on behalf of the observance of Sunday began in the Roman empire in an early part of the 4th century, as in the statute of Constantine (321), which runs as follows: "On the venerable day of the sun let all magistrates and people residing in the city rest, and let all workshops be closed. In the country persons engaged in agriculture may, however, according to their will and without violating this law, continue their toil, for often another day is not so suitable either for sowing grain or for planting vines; and if the proper opportunity for such operations be lost the bounty of heaven may be disappointed." While Constantine permitted the legal freeing of slaves and the visitation of captives on Sunday, he prohibited the prosecution of lawsuits. Theodosius (386) published a decree suspending the theatrical shows and circus races on Sunday. These historical facts are important as bearing on the present Sunday laws in England and America.

The Frank emperors kept up the observance of the Lord's Day by their capitularies or general statutes; and even during the French Revolution, when the Christian calendar was abolished, each tenth day was made a day of rest, and public offices, schools, workshops, and shops of merchandise, excepting those of food and medicine, were ordered to be closed. The Code Napoléon ordered the observance of Sunday.

In England the observance of the Lord's Day has been enjoined by statute from the earliest times. Canute (1028-35) prohibited marketing, hunting, and the holding of local courts on that day. After the Conquest the conduct of the people with regard to trade, sports, and the law courts was controlled by special statutes.

The most important legislation on the subject of Sunday usage is that which was promulgated in the reign of Charles II. (1676). By the law then passed a prohibition is imposed upon all worldly labor or business excepting works of necessity or charity, necessary traveling and the service of any legal writ excepting in case of high treason or treason, felony, or breaches of the peace; and it permits also the sale of food in inns and eating-shops.

The American colonists, especially in their early New England settlements, enforced the observance of the first day of the week by the most rigorous penalties. People were compelled by the laws of Massachusetts, Connecticut, Georgia, South Carolina and Virginia to attend public worship in a church or conventicle. It was only as time advanced that a distinction was made between the observance of Sunday as a civil and as a religious institution. (See SUNDAY.) Consult: Hessey, 'Bampton Lectures' (1860); Oehler, 'Theology of the Old Testament'; Proudhon, 'La Célébration du Dimanche'; Briggs, 'The Higher Criticism of the Hexateuch' (1893).

Sabba'tia, a genus of *Gentianaceæ*, often growing in sand or salt marshes. These plants have verticillate leaves, handsome terminal flowers, with white or pink rotate corollas 5 to 12-merous; 4 to 12 stamens with thread-like filaments, and two-cleft styles, capsules more or less globose, coriaceous, and containing many small reticulated seeds. Several species have a tonic, although bitter, juice, and are used as febrifuges. Although named in honor of an early Italian botanist, Sabbati, the genus is said to be so called because the Pilgrim Fathers discovered the local *S. stellaris* on a Sabbath. This charming species, called the marsh pink, or Rose of Plymouth, bears a very delicate pink flower, with a star-shaped yellowish eye.

Sabba'tians. See JEWISH SECTS.

Sabbat'ical Year, the seventh year which the law of Moses provided should be a year of rest for the land (Ex. xxiii. 10, 11; Lev. xxv. 1-7). The land was not to be sown and that which grew of its own accord was not to be reaped, but to be left for the poor to eat. Vineyards and oliveyards were also to be left uncultivated, and their produce ungathered; but the people were allowed to fish and hunt, and attend to their bees and flocks, and a triple produce was promised for every sixth year to make up for the deficiency of the seventh. The sabbatical year was also to be a year of release for Jewish debtors (Deut. xv. 1-6), but those who were able to lend were strictly enjoined not to refuse loans to poor and needy persons because the year of release was at hand (Deut. xv. 7-11). In this year also the law was to be read solemnly to all the people assembled at the feast of Tabernacles (Deut. xxxi. 10). This institution seems to have been almost entirely ignored during the period which preceded the captivity, and in 2 Chron. xxxvi. 21, the time of the captivity is represented as one in which the land was enabled, by the will of God, to enjoy the sabbaths or years of rest that the Israelites had omitted to allow it. After the captivity Nehemiah sought to secure the better observance of the septennial sabbath, as he did that of the weekly sabbath (Neh. x. 31), and he seems to have had some success in the former as well as in the latter effort. The historic fact that Alexander the Great remitted the Jewish tribute in the seventh year because the Jews were debarred by their religion from employing the means of raising it, shows that it was observed a hundred years after the time of Nehemiah.

Sabel'la, a genus of annelids dwelling on sandy shores in tubes formed solely of sand, the

particles of which are glued together by a natural cement secreted by them, thus forming a smooth regular tube, thus forming a striking contrast in its uniformity with the rougher dwelling-tubes of allied genera as *Terebella*. The worm itself possesses a slender body, the hinder part of which is doubled up within the tube. The head is provided with slender tentacles.

Sabel'lianism, the theological doctrine of Sabellius (q.v.), which, though the orthodox advocates, were condemned by the church as heretical. See MONARCHIANS.

Sabellius, sa-bēl'ī-ūs, Christian theologian, born at Pentapolis, Africa, or Italy. He was a pupil of Ptolemais in Upper Egypt during the reign of Zephyrinus (199-217) and (217-222), and is known as the sect who considered the Son and the Father only as different revelations or manifestations of the Godhead, but not as separate persons (see MONARCHIANS). The doctrine of Sabellius was opposed by Dionysius of Alexandria and Dionysius of Rome, by Epiphanius, who states that the Sabellians were driven out of Rome and into Mesopotamia by Theodoret. Saint Augustine states that the Sabellian heresy began in the beginning of the 5th century, and that it has since disappeared. Yet their views have adherents, and even now some attempt to reconcile theology with rationalism by rejecting conceptions of the Trinity which are based on that of Sabellius.

Sa'bians. See SABÆANS.

Sabin, sā'bīn, Edwin Legrand, writer: b. Rockford, Ill., 23 Dec. 1851; graduated from the University of Illinois; and has published: 'The Magic Mashie' (1900); 'The Magic Mashie' (1900).

Sabin, Joseph, American bibliographer: b. Braunston, Northamptonshire, Eng., 1821; d. Brooklyn, N. Y., 5 June 1881. He was in apprenticeship to Charles Richards of Oxford, he set up a bookshop there, but in 1848 came to this country where he conducted establishments for the sale of rare and valuable books and rare works in New York 1848-50, Philadelphia 1856-60, and New York 1860-61. His bibliographical knowledge was well known, and he said to have crossed the Atlantic 25 times for the purchase of unique books. From 1869 he published for a number of years 'The American Bibliopoliast.' He has several compilations, among them an uncompleted 'Dictionary of Book Collectors in America.'

Sabin, Oliver C., American Christian Science bishop: b. Kalamazoo, Ohio, 1840. His parents were members of the Christian Church, or Disciples of Christ. During the war he studied law and practiced for many years, was also engaged in engineering and publishing, and interested in politics. After being connected with various enterprises in Illinois, Nebraska, and Washington, D. C., where he settled in Washington, D. C., where after a thorough investigation of the Christian Science methods of healing, he was converted to the Evangelical Christian Church, the work of which has since spread rapidly. He has held various business positions and

SABINE—SABINE CROSS ROADS

preach the Gospel with voice and pen most successfully.

Sabine, sǎb'ĭn, **SM** **Edward**, English physicist: b. Dublin, Ireland, 14 Oct. 1788; d. Richmond, Surrey, 26 June 1883. He was educated at the military colleges of Marlow and Woolwich and in 1803 entered the army where he was commissioned 2d lieutenant of artillery. He served in the war with the United States in 1813-4 and accompanied Ross and Parry in their Arctic expedition in 1818 and that of Parry in 1819-20. While on these expeditions he engaged in researches in terrestrial magnetism and in 1821-5 conducted a series of voyages extending from the Arctic regions to the equator, gathering data concerning the magnetic needle, the figure of the earth and other points in meteorological and terrestrial physics. He was instrumental in the establishment of permanent magnetical and meteorological observatories, retaining directorship of those in the colonies for many years. In 1818 he was elected to the Royal Society, was its vice-president in 1850 and in 1861-71 acted as its president. He received rank as lieutenant-general in the army in 1859 and was retired with full rank as general in 1874. His works include: 'An Account of the Experiments to determine the Figure of the Earth' (1825); 'The Variability of the Intensity of Magnetism upon Many Parts of the Globe' (1838); etc.

Sabine, sǎ'b'ĭn, **Lorenzo**, American historian: b. New Libson, N. H., 28 Feb. 1803; d. Boston, Mass., 14 April 1877. He sat in the New Hampshire legislature for three successive terms, but removed to Massachusetts in 1849, and was a Whig member of Congress in 1852-3. He is best known for his important work on 'The American Loyalists, or Biographical Sketches of Adherents to the British Crown in the War of the Revolution' (1847). He also published 'Life of Preble' (1847); 'Reports on the Principal Fisheries of the American Seas' (1853); 'Notes on Duels and Duelling, with a Preliminary Historical Essay' (1856); etc.

Sabine, sǎ'b'ĭn, **Mountains**, Italy, a branch of the Apennines, near the border of ancient Latium, east of Rome, is a lofty group in the upper valley of the Aternus; the highest summit reaches an altitude of about 4,200 feet.

Sabine, sa-bĕn', a river of the United States, which has its rise in the northeastern part of Texas, in Hunt County, flows southeast about 250 miles, then turns southward and forms the boundary between Texas and Louisiana, and enters the Gulf of Mexico through Sabine Lake and Sabine Pass. The mouth of the river is Sabine Pass, a narrow channel which is obstructed by a muddy bar. Considerable has been done to make this Pass safe for navigation; jetty-building and dredging was begun as soon as the interior of Texas, near the Sabine River, was settled. Sabine Lake is an expansion of the river, but the Neches River also enters the lake. The Sabine River is about 500 miles long and is navigable in its lower course.

Sabine Cross Roads, Battle of, and Banks' Retreat to Alexandria. Three miles southeast of Mansfield, De Soto Parish, La., one of the main roads from Alexandria to Shreveport is crossed by a road from Red River

to Sabine River. At this crossing was fought a battle which marked the culmination and failure of what is known as the Red River Expedition. On 23 Jan. 1864 Gen. Banks, then at New Orleans, received a despatch from Gen. Halleck, dated the 4th, proposing an expedition, to consist of the forces of Banks, Steele, and such as could be spared by Sherman, for the capture of Shreveport, La., on Red River, and the recovery of Texas, thus opening access to the cotton of that section and stimulating trade. Banks had, on a previous occasion, for sound reasons, objected to such a campaign, but now acquiesced and promised a cordial co-operation; but he set forth the difficulties in the way, and made suggestions to remove them, not one of which was regarded. Engrossed with duties concerning political affairs in Louisiana, which had specially been confided to him by the President, Banks could not immediately leave New Orleans, and he entrusted the arrangements of the expedition to Gen. W. B. Franklin, his second in command, who was to move from the Teche 5 March, reach Alexandria on the 17th, and co-operate with a strong fleet under command of Admiral Porter. Porter arrived at the mouth of Red River on 7 March, with a fleet of 15 ironclads and four light steamers, and there he was joined some days later by transports from Vicksburg, carrying four divisions of Sherman's army, under Gen. A. J. Smith, and the Marine brigade of Col. Ellet. A part of the plan of campaign was that Gen. Steele, with an army of 15,000 men, should move from Little Rock, Ark., directly on Shreveport; but Steele, after marching from Little Rock to Camden, was checked, fell back to Little Rock, and took no further part in the campaign. (See JENKINS' FERRY, BATTLE OF.) Smith's forces advanced, attacked and in conjunction with the navy, 14 March, captured Fort de Russy, up Red River, together with 283 prisoners, 10 guns, and many small arms, the Confederate covering force of 3,500 men, under Gen. Walker, after burning two steamboats and a considerable quantity of cotton, retreating up the river. It was not until the 19th that Franklin, with very little opposition, which was brushed aside by his cavalry, reached Alexandria; Banks joined him on the 24th, but his entire column did not close up until the 26th. Meanwhile Gen. Mower, with three brigades of Smith's division and a cavalry brigade of the Nineteenth corps, marched from Alexandria on the 21st for Henderson's Hill, 25 miles westward, surprised the 2d Louisiana cavalry, and with slight loss captured 250 men, nearly as many horses, and four guns, with their caissons. Near Alexandria the fleet came to a series of rapids, and the water was so low that the ironclads could not run up them, but after a week's hard labor the lighter ones were carried over. The transports, which could not pass, returned to Vicksburg, and with them Ellet's 3,000 men. The withdrawal of the transports made it necessary to establish a base at Alexandria and the use of a wagon-train to carry the supplies, and the further necessity of leaving a guard of nearly 4,000 men (under Gen. Grover) to protect the place. Gen. Franklin, with the main column, advanced on the road running west of and parallel to the river, to Natchitoches, about 80 miles above Alexandria, driving before him the Confederate cavalry, and reaching Natchitoches on 3 April, where he was

joined by A. J. Smith's column, which, accompanied by Porter's fleet, had come to Grand Ecure, four miles from Natchitoches. Porter had a fleet of 13 gunboats and 30 transports.

Banks' army, on the eve of march from Natchitoches for Shreveport, was composed of two divisions of the Thirteenth corps, under Gen. T. E. G. Ransom; five brigades of the Sixteenth corps, under Gen. A. J. Smith; Gen. W. H. Emory's division, three brigades, of the Nineteenth corps; and Col. Dickey's brigade of colored troops, under Gen. Franklin; Gen. A. L. Lee's division of cavalry and mounted infantry, four brigades; and a small artillery reserve, under Capt. Closson. These numbered 31 March 25,735 officers and men, with about 65 guns. Lee's cavalry force of 4,500 men had pushed out westward, 12 miles; on 2 April it ran across Confederate cavalry, drove it back eight miles, and then withdrew to wait for the general advance. The general advance began on the morning of the 6th, led by Lee's cavalry, followed by the two small divisions of the Thirteenth corps, under Ransom, and by Emory, with a division of the Nineteenth corps and Dickey's brigade of colored troops. On the morning of the 7th A. J. Smith followed with Mower's division of the Sixteenth corps. A division of the Seventeenth corps, 1,730 strong, under Gen. T. Kilby Smith, remained with the transports, under instructions to conduct them to Loggy Bayou, opposite Springfield, about midway between Natchitoches and Shreveport, 110 miles by the river, above Grand Ecure, where he was to halt and communicate with the army at Sabine Cross Roads, 54 miles from Grand Ecure. Porter, Smith, and the transports, with six gunboats carrying 17 guns, started on the 7th.

Lee's instructions from Gen. Franklin were to attack the enemy wherever found, but not to bring on a general engagement. On the 7th he drove a brigade of Gen. Green's beyond Pleasant Hill, and came upon a strong force under Green at Wilson's Farm. Lee attacked and after a hard engagement of two hours drove Green to Saint Patrice's Bayou, eight miles from Pleasant Hill. Here Lee bivouacked for the night, and sent back for infantry support. His loss had been 53 killed and wounded. Green's loss was greater, including about 100 prisoners. That night Franklin reached Pleasant Hill; A. J. Smith's division was still a day's march in rear of Franklin. At daybreak of the 8th Lee, having been reinforced by one of Landram's brigades of the Thirteenth corps, dropped his wagon-train, and, moving forward, drove the Confederates from Saint Patrice's Bayou and gradually pushed them to a wood beyond a clearing at Sabine Cross Roads, and found himself in the immediate front of Gen. R. Taylor's army of 10,000 men. Taylor, whose forces had been much scattered, in Arkansas, Louisiana, and Texas, had concentrated them, and near Mansfield had the three divisions of Gens. Green, Walker, and Mouton—10,000 men. On the morning of the 8th he moved three miles from Mansfield to Sabine Cross Roads and formed line in the edge of a wood, commanding, on both sides of the road, a clearing about 1,200 yards long, and 800 wide, through the middle of which was a deep ravine. He knew that Banks' column was stretched out on a single road for more than 20 miles, and was sanguine of success in

attacking the head of it. Lee threw out a strong skirmish-line and waited for Banks' main body to come up. At noon Ransom arrived with a brigade, and line was formed. Banks rode up a little past noon, and sent back repeated orders for Franklin to hurry forward. After heavy and continuous skirmishing, lasting until 4:30 p.m., Taylor threw his entire force of 10,000 men heavily upon the Union line; Mouton's division and two brigades of dismounted cavalry made an impetuous charge upon the Union right, in which Mouton was killed at the first onset, while Walker's division and a brigade on its right fell upon the centre and left of the line. For nearly an hour the men (not over 4,500) of Banks' command resisted this attack, and then were compelled to fall back to the woods in rear of the open space at the cross roads, with heavy loss, including three guns. Franklin had come up with Cameron's division of the Thirteenth corps, and a new line was formed, to be immediately broken by heavy attacks on both flanks and front. The Confederates were gaining the rear, and the Union line was pressed back along the narrow forest road filled with wagons and mules of the supply-train, stragglers, and camp-followers, which so blocked the way that an orderly retreat was impossible. Soon a panic set in, the cavalry train of 156 wagons was captured; Ransom's ten guns were taken, along with 1,000 of his men; Franklin and Ransom were wounded; some of the best officers were struck down; and in spite of the heroic efforts of Banks and others to rally them, nearly the whole army broke into a disorderly retreat, which was checked only at Pleasant Grove, three miles from the field of battle. Here Gen. Emory, with his division, had come up at 6 p.m., and formed line in the edge of a wood, on a ridge overlooking a small stream; and scarcely had his line been formed when the panic-stricken fugitives came rushing back through it to the rear. The Confederates were close on their heels, made an immediate assault upon Emory, and were met with a severe fire delivered at close quarters that instantly checked them. After an hour and a half of fierce battle, in which they made desperate efforts to turn Emory's right, the Confederates were everywhere repulsed with great loss, but held the shores of the stream. Banks' army, after having advanced to within two marches of Shreveport, had been saved from total destruction "by a triumph of valor and discipline on the part of a single division and of skill on the part of its intrepid commander." The action is known as the battle of Pleasant Grove. The Union loss at Sabine Cross Roads and Pleasant Grove was about 1,050 killed and wounded and nearly 1,800 missing; the Confederate loss, 1,500 killed and wounded.

Banks had been limited as to time in carrying out the objects of his campaign. Gen. Sherman was calling for A. J. Smith's troops, and Gen. Grant, who had set his heart on a movement by Banks from New Orleans on Mobile, had written him: "I had much rather that the Red River expedition had never been begun, than that you should be detained one day beyond the first day of May, in commencing the movement east of the Mississippi." The allotted time was fast expiring, and Banks concluded to abandon his expedition. The night of the 8th he fell back 15

SABINE PASS

miles to Pleasant Hill, which was reached by Emory's division, that brought up the rear about 9 o'clock next morning. A. J. Smith, with a part of his command, had halted at Pleasant Hill, on the evening of the 8th, and with less than 13,000 men Banks formed a double line; the first, of the Nineteenth corps, along a thickly wooded slope half a mile west of Pleasant Hill; the second, of A. J. Smith's command and the artillery, on a plateau in rear. The trains, preceded by Lee's cavalry and Dickey's brigade of colored troops, and followed by the remnants of Ransom's division, were put on the road to Grand Ecore. Gen. Taylor, reinforced by the divisions of Gens. Churchill and Parsons, had followed Banks very cautiously, and at noon his advance appeared and began skirmishing. Later artillery was brought up and opened fire, and a demonstration was made on the Union right. About 5 P.M. three Confederate divisions charged out of the woods upon the left flank of the Union line, which was steadily driven back up the hill to the cover of the second line. Here the Confederates were repulsed with great loss. Meanwhile the right of the Union line, though hard pressed, stood firm until, the left being driven back, it was nearly enveloped and gave ground, and the Confederates pressed on to an attack on A. J. Smith, who held the second line in reserve. After a short and sharp exchange of fire, Smith's and part of Emory's men made a charge and pushed back the Confederate line. All the reserves were now thrown into action, and the Confederates were routed, driven from the field, and pursued until dark. Gen. E. Kirby Smith, the Confederate department commander, says: "Our troops attacked with vigor and at first with success, but, exposing their right flank, were finally repulsed and thrown into confusion. The Missouri and Arkansas troops, with a brigade of Walker's division, were broken and scattered. The enemy recovered cannon which we had captured the day before, and two of our pieces with the dead and wounded were left on the field. Our troops were completely paralyzed and disorganized by the repulse. . . . Our repulse at Pleasant Hill was so complete and our command was so disorganized that had Banks followed up his success vigorously he would have met but feeble opposition to his advance on Shreveport."

Banks had engaged at Pleasant Hill 12,600 men, of whom 150 were killed, 844 wounded, and 375 missing. Taylor had 14,300 engaged, of whom about 1,000 were killed and wounded, and nearly 500 missing.

Encouraged by his success at Pleasant Hill, Banks gave orders for a forward movement next morning on Shreveport, and preparations were being made for the march, when Gen. Franklin and other officers dissuaded him from it, and it was decided to fall back to Grand Ecore and unite with the fleet. The retreat was resumed during the night and Grand Ecore reached on the 11th. E. Kirby Smith joined Taylor after the close of the battle of Pleasant Hill, and determined to move against Gen. Steele in Arkansas. Taylor withdrew his infantry to Mansfield on the 10th and 11th, leaving the cavalry, under Green, and Polignac's infantry division of 2,000 men to watch and harass Banks. Upon his arrival at Grand Ecore Banks intrenched, threw a pontoon-bridge across the

river, put part of his force on the other side, and waited for the fleet to come down. Porter, with the gunboats, and Kilby Smith, with the transports, had arrived at Loggy Bayou on the afternoon of the 10th, where, two hours later, they received news of Banks' misfortunes, and on the morning of the 11th received his orders to return to Grand Ecore. The fleet turned down stream, but it was not to reach Grand Ecore without opposition. On the evening of the 11th Green, who had been left at Pleasant Hill, started with 750 men and two batteries for Blair's Landing, and on the 12th, with about 500 men and three guns, attacked the fleet and transports as they were running down the river. A brisk fight followed, Gen. Green was killed by a discharge of grape from one of the gunboats, and his men were driven off, with small loss. The Union loss was 57 killed and wounded. By the 15th all the gunboats were back to Grand Ecore, and as fast as the vessels could pass the bar they made their way to Alexandria, one gunboat being lost. The fleet having passed down, Banks marched from Grand Ecore on the 22d for Alexandria, and that night bivouacked at Clouterville, 32 miles from Grand Ecore. The march was resumed on the 22d, and on the morning of the 23d, while marching along Cane River, a branch of the Red, the head of the column was checked at Monett's Ferry by Gen. Bee, with four brigades of 2,000 men and four batteries. Bee's position was a strong one on a bluff commanding the crossing, and on the only practicable road to Alexandria, 35 miles distant. At the same time the Confederate cavalry under Gen. Wharton and Polignac's infantry were harassing Banks' rear. Gen. Birge, with his own brigade and Cameron's division of the Thirteenth corps, in all about 5,000 men, crossed Cane River three miles above the ferry, and by a difficult flank march of several miles reached a hill, the occupation of which rendered Monett's Bluff untenable. Birge attacked at 2 P.M., after a contest of two hours carried the hill, and the Confederates retreated and left open the road Alexandria. The Union loss was 150 to 200 killed and wounded. Banks resumed his march on the 24th, and without further serious opposition entered Alexandria on the 25th. Banks reports that in the 24 days intervening between the march of the army from Alexandria and its return there his own army had marched 400 miles. He had fought several battles, and been successful in all but one, and his losses were 289 killed, 1,541 wounded, and 2,150 missing, an aggregate of 3,980. The difficulty of getting Porter's fleet over the shallow rapids near Alexandria detained Banks at that place until 13 May, when he continued his retreat. (See *YELLOW BAYOU, ENGAGEMENT AT, AND BANKS' RETREAT FROM ALEXANDRIA.*) Consult: 'Official Records,' Vol. XXXIV.; Taylor, 'Destruction and Reconstruction'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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Sabine Pass, Engagement at. On 6 Aug. 1863 Gen. Halleck informed Gen. Banks, in command at New Orleans, that there were important reasons why the United States flag should be restored at some point in Texas, with the least possible delay. Halleck's despatch was by direction of the Secretary of War, and it

was understood that the proposed movement was of diplomatic rather than a military character, and intended to prevent European complications. Banks was left to his own judgment to conduct the campaign, but it was suggested that the most feasible route would be by the Red River to Shreveport. Banks, deeming the Red River route impracticable at that season of the year, fitted out an expedition to make a lodgment in Texas at Sabine City, on Sabine Pass, the outlet from Sabine Lake into the Gulf of Mexico, and the terminus of a railroad penetrating eastern Texas, and making connection with Houston, the capital of the State. Gen. Franklin was put in charge of the advance of the expedition of 5,000 men, and was instructed to land a few miles below Sabine Pass, move upon the Confederate works commanding it, and, if practicable, to seize Beaumont, on the railroad to Houston. Four light-draft gunboats, under command of Lieut. Crocker, formed part of the expedition, which sailed from New Orleans on 4 September. Franklin disregarded his instructions to land 10 or 12 miles below Sabine Pass, and on Crocker's representation that he could silence the Confederate works in the pass, he and Crocker arranged for the gunboats to make a direct attack upon the works, drive out the garrison, seize or drive away two Confederate gunboats reported on the river, and then land the troops. From the army 150 sharpshooters were distributed on the four gunboats. Early in the forenoon of the 8th the gunboats and transports crossed the bar at Sabine Pass, and in the middle of the afternoon three of the gunboats opened fire upon the small fort, mounting eight heavy guns, and held by 44 officers and men. The fire was immediately returned, two of the gunboats were disabled and surrendered, and were taken in tow by two small Confederate craft. It was all over in less than an hour. Franklin made no serious attempt to land his troops, but immediately returned to New Orleans, having lost two gunboats, with their 15 heavy guns, nearly 50 killed and wounded, and over 200 prisoners, among them Lieut. Crocker, of the navy. Not a Confederate was hurt. Consult 'Official Records,' Vol. XXVI.

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Sabines, sā'bīnz (Latin, SABINI, sa-bī'nī), a people noted in the early history of Rome, whose territory they adjoined. As a people the Sabines were engaged in agriculture and grazing, and from the simplicity of their lives and their physical prowess they obtained a reputation like that of the Spartans for severity of discipline and sturdiness of character. The narrow limits of the Sabine territory made emigration necessary, and probably in this way they came in contact with the growing power of Rome. They fought the Romans with great courage, but were subdued about 290 B.C., and admitted to Roman citizenship, but not permitted to vote in civic affairs. They became merged in the republic and subsequent empire, and became lost to view as a separate people.

Sabinus, Masurius, Roman jurist. He flourished during the reign of Tiberius, and was a pupil of Capito. He was the founder of the school of Sabiniani, and was the author of several works much used and commented upon by

later jurists, the most important iii. *Juris Civilis*, which is not now

Sable, one of the fur-be: (*Mustela zibellina*), found in Russia and Kamchatka, or its A sentative (*M. americana*) which that it is doubtfully named as a s The average length of the sabi inches, excluding the tail, which bushy. The body partakes of the weasels generally, in that it is vermiform. The fur is smooth, g be pressed or smoothed in any d to the mode of attachment of the skin. In color it is a rich deep near the head may exhibit white frequently assumes a gray tint a The fur is heaviest during winter, gers experienced by the sable sudden snow-storms obliterating from the inclement cold, can h estimated. Sables are for the mos in traps, but are cautious anin pursuit is attended with much d make their homes in dens or cav trees, and produce from three to a birth, the young being born in N and their general habits are those ten and weasel, but they are m tiring.

Skins of the Russian sable 1 Liverpool ranging from three t The darkest skins are considered 1 About 2,000 skins annually find England. Most of these furs are where about 25,000 are said t collected. When manufactured f furs may fetch prices so high as The corporation robes of the Lo are lined with this expensive m tails of sables are used in the r artists' brushes. See FUR-BEARING FUR-TRADE.

Sable Antelope, one of the most handsome of African ante (*tragus niger*), of the same genus antelope, blaubok, and others, and idly approaching extinction, as ci and more encroaches upon the p ern and eastern Africa. Its coat i black, markings upon the face, th the under parts being white. Th horns sweep back from the foreh like curve, and the neck is ad mane. These antelopes went abou in herds, and were prizes for t while their flesh was excellent t sive descriptions may be found i of Gordon-Cumming, Anderson, Bryden, and other African sports.

Sable, Cape. See CAPE SABI

Sable Island, a low-lying Atlantic, in lat. 44° N. and 10 miles east of Nova Scotia. It sand-dunes enclosing a lagoon, menace to navigation that the Canada maintains two lightho was formerly 40 miles long and gradually sinking. Upon its sanc cranberries and wild grass, and being made to grow pines and oth

SABOTS — SACCHAROMETER

greens. There are sandbanks in the vicinity. The only inhabitants are the lighthouse and lifeboat men attached to the establishment for the relief of shipwrecked persons. The island is known for its breed of hardy wild ponies.

Sabots, sa-bōz', shoes for women largely worn by the peasantry of France, Belgium, Holland, and some other parts of Europe. They are especially useful in wet weather, and in moist places generally, being well adapted to preserve the feet from damp. Great numbers of sabots are exported by France to Belgium. In some parts of England, as in Lancashire, shoes with thick wooden soles, but with leather vamps or "uppers," are worn by most of the artisan class. See **BOOTS AND SHOES**.

Sabre-Tache, sā-br-tāsh, a leathern case or pocket worn by cavalry officers at the left side, suspended by three straps from their sword-belt. It came into use when the jackets of cavalry soldiers were too short or too tight to admit of pockets being made in them, but is now rather ornamental than useful.

Sabre-toothed Tigers, extinct cats of the family *Macharodontidae* (or *Nimravidae*), a group whose remains occur as fossils from the Eocene up to the Pleistocene. They differ from ordinary cats (*Felidae*) in several anatomical features, having some peculiarities which ally them to the bears, and others recalling existing viverrids, as the foussa (*Cryptoprocta*). They are remarkable for the character of the dentition, which in the earlier genera comes near showing the complete number of teeth, but displays a steady tendency as the family history is followed toward the reduced number possessed by existing cats. At the same time the dentition is often distinguished by the huge size of the upper canines, which in some cases were five or six times as long as the neighboring teeth, and have been justly called "sabre-teeth." These tushes reached their highest development in the genus *Macharodus*, whose species were of very wide distribution, occurring in both North and South America and in Europe. These carnivores were of various sizes, up to dimensions equal to those of modern tigers, and so little different in general from true cats that Cope places them within the *Felidae*. It began in the Eocene and continued down almost or quite to the Glacial Period, when the type seems to have become extinct because the great canines had overgrown usefulness and become a hindrance instead of a help in getting a living. They finally became so large that the animal could not open its mouth wide enough to make use of them in biting, and the space between them would admit none but a very small piece of meat to enter, even if a large piece could be torn away. "Even when the mouth opens so far as to allow the mandible to pass behind the apices of the canines," remarks Cope, "there would appear to be some risk of the latter being caught on the point of one or the other canine, and forced to remain open, causing early starvation." Other prominent genera in the family are the plantigrade *Dinictis* (q.v.); *Nimravus* and *Pogonodon*, with species as large as panthers; and *Hoplophoneus*, with dentition like modern cats. Consult: Flower and Lydekker, 'Mammals, Living and Extinct' (1891); Cope, 'Vertebrates of the Tertiary Formation of the West,' Rept.

U. S. Geol. Survey, Vol. III. (Washington, 1884); Woodward, 'Vertebrate Palæontology' (1898).

Sac (sāk) **City**, Iowa, county-seat of Sac County; on the North Fork of the Raccoon River, and on the Chicago, M. & St. P. and the Chicago & N. W. R.R.'s; about 42 miles west by south of Fort Dodge. It is in an agricultural region where considerable attention is given to raising live stock. The chief manufacturing industries are connected with farm products. The trade is chiefly in farm and dairy products, flour, and agricultural implements. The educational institutions are the Sac City Institute (Baptist), a high school, public elementary schools, and a public library. Pop. (1890) 1,249; (1900) 2,079; (1910 est.) 2,300.

Sac Fungi. See **FUNGI**.

Sac-à-Lait, sāk'a-lā, a fish. See **CRAPPIE**.

Sac'but, or **Sackbut**, the word by which translators have rendered the *sabbeka* of the Hebrew Scriptures. The exact form of the sabbeka has been much disputed, but that it was a stringed instrument is certain, for the name passed over into Greek and Latin in the forms *sambuke*, *sambuca*, and the instrument so called is described by Athenæus as a harplike instrument of four or more strings, and of a triangular form. It is not unlikely that this instrument was introduced among the Jews from the East, since one of the musical instruments most frequently occurring in the Assyrian sculptures answers very closely to this description, and may perhaps be identified with the sabbeka, the name of which is, besides, Chaldaic. Nothing resembling this Assyrian instrument is to be found on the Egyptian monuments or in the sculptures of Greece and Rome. Since the sabbeka was a stringed instrument the rendering sacbut is altogether wrong, since that was, at the time when our translation of the Scriptures was made, the name of a wind-instrument now called the trombone. See **TROMBONE**.

Sac'caton Grass. See **GRASSES OF THE UNITED STATES**.

Saccharin, sāk'a-rīn, $C_6H_4\langle\begin{smallmatrix} CO \\ SO_2 \end{smallmatrix}\rangle NH$, benzoic-sulphinid, a sweet substance discovered by Remsen and Fahlberg in 1879. It is prepared from toluene by a series of chemical processes. White crystals soluble in hot water, alcohol, and ether. Its characteristic and most valuable property is its intense sweet taste, being about 550 times sweeter than cane-sugar so that a solution of one part in ten thousand parts of water has a perceptible taste. It has an extensive use as a sweetening agent in the manufacture of various beverages, preserves, jellies, etc., and may be used by diabetic patients who cannot use sugar. It has not, however, the food value of cane-sugar.

Saccharine forms salts with bases, the sodium salt being frequently used in place of saccharin because of its greater solubility.

Saccharom'eter, or **Saccharimeter**, any instrument used to determine the strength of a sugar solution. One common form is a hydrometer with the stem so graduated as to read per cents of sugar content in solution examined. Another is a form of polariscope devised

by Mitscherlich with the scale on which the angle of deviation of the plane of polarized light is read so graduated as to show the percentage of sugar in the solution used.

Saccoph'arynx, a genus of *Muraenidae*, with a single species (*S. flagellum*), a deep-sea conger eel, of which only three specimens have been observed: muscular system very feebly developed; bones thin and soft, wanting in organic matter; head and gape enormous; stomach distensible in an extraordinary degree; vent at end of trunk. The specimens known have been found floating on the surface of the North Atlantic with their stomachs much distended, having swallowed some other fish many times their own weight. They attain a length of several feet. See DEEP SEA EXPLORATION.

Sacheverell, sä-shëv'ë-rël, **Henry**, English Anglican divine: b. Wiltshire about 1674; d. London 5 June 1724. He was educated at Oxford and in 1705 was appointed preacher of Saint Saviour's, Southwark. While in this station he, in 1709, preached two famous sermons, the object of which was to rouse apprehensions for the safety of the Church, and to excite hostility against the Dissenters. Being impeached in the House of Commons he was brought to trial in February 1710, and on 23 March, when the trial was concluded, was suspended from preaching for three years. This prosecution, however, excited such a spirit in the High Church party that it helped to overthrow the ministry of Godolphin, and established the fortune of Sacheverell, who, during his suspension, made a kind of triumphal progress through the kingdom. The same month that his suspension terminated (1713) he was appointed to the valuable rectory of Saint Andrew's, Holborn, by Queen Anne. Of the offending sermons 40,000 copies at least were sold, and of the record of the trial 30,000. Little was heard of Sacheverell after this party ebullition subsided, except through his numerous squabbles with his parishioners. His abilities, even according to writers on his own side, were very slight. Consult Stanhope, 'History of Queen Anne's Reign' (1872).

Sachs, säks, **Bernard**, American neurologist: b. Baltimore, Md., 2 June 1858. He was graduated from the University of Strasburg, Germany, in 1882, and engaged as a medical practitioner in New York. He has made a specialty of the study of nervous diseases, regarding which he is a recognized authority. Besides numerous medical monographs he has published 'Mental and Nervous Diseases of Children' (1894).

Sachs, Edwin O., English architect: b. London 5 April 1870. He was educated at University College School, London, and at the University of Berlin, and engaged as an architect in London in 1892. He has established a wide practice in connection with theatres and public buildings and in 1898 applied electrical power to the working of the stage for the first time in England. He founded the British Fire Prevention Committee in 1897 and organized the first International Fire Prevention Congress in London in 1903. He has published: 'Modern Opera Houses and Theatres' (3 vols., 1896-8); 'Facts on Fire Prevention' (1902); 'Stage Con-

struction' (1898); 'Fires and Elements' (1897).

Sachs, Hans, hänts zäks, (C singer: b. Nuremberg 5 Nov. 1 Jan. 1576. He was by trade a followed his business and made equal assiduity. From 1510 to over different parts of Germany; craft, according to the custom of men, in all the towns he visited year he returned to his native was admitted as master in his; attached himself to the Reformers to the spread of which among he contributed not a little by a 1523, 'Die Wittenbergisch Nac jetz höret überall,' in which approval the cause of Luther. with the army of Charles V. productions of Hans Sachs are merous. In 1536 he estimated the poems at 5,000 or more. Three poems were published during 1 two more after his death. In the after the introduction of a mor into German poetry, Hans Sachs from which he was not withdrawn who had become acquainted with studies for 'Faust,' drew attention in a poem (Erklärung eines al vorstellend Hans Sachsens dung') which appeared in the kur' (April 1776). The best works is that of Keller and best selection that of Gödeke: 'Deutsche Dichter des sechzehnderts' (2d ed., 1883-5). He poet genius, and, notwithstanding the language, his poems are distinguished by naïveté, feeling, invention, wit, scription. Consult: Schwe (1889); Goetze's 'Hans Sachs' 'Hans Sachs und seine Zeit' (scher, 'Studien zu Hans Sachs')

Sachs, Julius, German botanist 2 Oct. 1832; d. Würzburg 29 studied at Prague where he became botany, and in 1867 became professor at Freiburg. The following year Würzburg, where in his own laboratory extremely important experiments of plants. He published 'Experimental-Physiologie der Pflanzen' (Lehrbuch der Botanik) (1868-9) 'über Pflanzenphysiologie' schichte der Botanik vom 16. (1875); 'Gesammelte Abhandlungen der Pflanzenphysiologie' (1892-3).

Sachse, säks, **Julius Friedrich** author: b. Philadelphia, Pa., 22 engaged in journalism and has sively, his publications including 'Pietists of Provincial Pennsylvania: 'Horologium Achaz-Christoph Artifex'; 'Justus Falckner, My (1903); 'Pennsylvania: the German Settlement and Development Separatists of Pennsylvania, 170

Sachsenhausen, zäks'sën - FRANKFORT-ON-THE-MAIN.

Sachsenspiegel, zāk'sën-spē'gël, a private collection of legal precepts and legal customs which had the force of law in the Middle Ages in Germany, especially in the north of Germany. One of the six prefaces to the collection mentions one Eyke von Repgow as its author, and this account is generally accepted as true. Its date is supposed to be earlier than 1235. The study of it has been revived in Germany. The best edition is by Homeyer (Berlin, 1835-44).

Sack, a general name for the different sorts of dry wine, more especially the Spanish, which were first extensively used in England in the 16th century.

Sack'but. See SACBUT.

Sacketts (sāk'ëts) **Harbor**, N. Y., village, in Jefferson County; on Black River Bay, the inlet through which Black River discharges its waters into Lake Ontario; and on the Rome & Watertown railroad, which is a branch of the New York Central & Hudson River railroad. The village is about 10 miles from Watertown, eight miles from Lake Ontario, and 170 miles west-northwest of Albany. It has a good harbor, large enough to accommodate vessels of the largest size, and it has steamer connections with several of the lake ports. Sacketts Harbor is one of the oldest places on the northern frontier; in 1809, the Oneida, the first United States war vessel, was built here. In the War of 1812 the village was the scene of several engagements, and was an important United States naval station. The frigates *Madison* and *Superior*, war vessels, were made here in 40 and 80 days respectively, from the time the timber was cut. A third warship was nearly completed when peace was restored; the hulk remained in the yard for a number of years. The United States military station, *Madison Barracks*, is located here. Sacketts Harbor is in an agricultural region, and although it has good water power, there is but little manufacturing. Pop., exclusive of garrison (1910) 868.

Sackville, sāk'vil, **Charles**, 6TH EARL OF DORSET, English courtier and poet: b. 24 Jan. 1637; d. Bath 29 Jan. 1706. He became a wit and roisterer in the company of Charles II., served under the Duke of York in the sea fight with the Dutch in 1663 and is said to have written or retouched on the night before the engagement of 3 June his famous song, "To all you ladies now on land." He succeeded to his title in 1677, but did not stand well in the favor of James II., and later became an ardent supporter of William of Orange, under whom he was lord chamberlain of the household from 1689 to 1697, and three times one of the regents during the king's absence. He was a patron of poets like Prior, Wycherley and Dryden, and from the last named received the dedication of the "Essay on Satire."

Sackville, Lionel **Sackville Sackville-West**, BARON, English diplomatist: b. Cambridgeshire 19 July 1827. After a private education, he entered the diplomatic service in 1847, was made secretary of legation at Turin (1858), Madrid (1864), Berlin (1867), and Paris (1868), and was envoy extraordinary and minister plenipotentiary successively to the Argentine Confederation (1872-8) and to Spain

(1878-81). In 1881 he was appointed minister to the United States, and in 1888 with Joseph Chamberlain and Sir Charles Tupper negotiated the fisheries treaty of that year. In October 1888 he received a letter from one C. F. Murchison, who, representing himself as an Englishman naturalized in the United States, asked for which party he should vote in the ensuing Presidential election. The minister in reply advised his correspondent to vote the Democratic ticket as favorable to English interests. The Murchison letter was generally regarded as a trap set for the embarrassment of the minister. His recall was at once asked for, and in default of a prompt compliance with the request the Department of State sent him his passports 30 October. The incident, occurring as it did during a Presidential canvass, was the subject of much discussion.

Sackville, **Thomas**, EARL OF DORSET and BARON BUCKHURST, English statesman and poet: b. Withyham parish, Sussex, 1536; d. London 19 April 1608. He was a member of the University of Oxford, but removed to Cambridge, and afterward became a student of the Inner Temple. At both universities he was distinguished for his performances in Latin and English poetry, and in the Temple wrote the last two acts of the tragedy of 'Gorboduc, or Ferrex and Porrex' (1565). Of a poem intended to comprehend a view of the illustrious but unfortunate characters in English history, entitled the 'Mirror for Magistrates,' he finished only a poetical preface (the 'Induction') and one legend on the life of the Duke of Buckingham. The work was completed by George Ferrers and Richard Baldwin (1559-63). He sat in the Parliament assembling 20 Jan. 1558, and in the first two Parliaments of Elizabeth (1559-63) after which he traveled. In 1586 he was made a member of the court appointed by Elizabeth to try Mary Queen of Scots. In 1598 he was joined with Burleigh in negotiations for peace with Spain, and renewed a treaty with the United Provinces. On the death of Burleigh, he became lord high treasurer. In January 1601 he was appointed lord high steward, and presided at the trial of the Earl of Essex. On the accession of James I. his post of treasurer was confirmed to him, and in 1604 he was created Earl of Dorset. He ranks among the most prudent and able of the ministers of Elizabeth, was a good speaker and a still better writer. The tragedy of 'Gorboduc,' the subject of which is a sanguinary story from early British history, is the first example in English of regular tragedy in blank verse. Sackville's share is inferior in literary value to his 'Induction,' called by Sidney Lee the greatest English poem between the 'Canterbury Tales' and the 'Faerie Queene.'

Saco, José Antonio, hō-sá' ān-tō'nē-ō sāk'kō, Cuban historian and publicist: b. Bayamo, Cuba, 7 May 1797; d. Madrid, Spain, 26 Sept. 1879. He was educated in Havana and in 1821 was appointed professor of philosophy in the Seminary of San Carlos. In 1832-4 he lived in Havana and edited the 'Revista Bimestre Cubana,' but his liberal and anti-slavery principles caused his banishment, though he was afterward allowed to return. He traveled in Europe and in 1840 settled in Paris where he resided for many years. He was elected a dele-

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gate to Madrid in 1866 to advocate political reforms for Cuba and in 1878 was elected to the Spanish cortes. He wrote: 'Paralelo entre Cuba y algunas colonias inglesas' (1838); 'Supresión del tráfico de enclavos en Cuba' (1845); 'Ideas sobre la incorporación de Cuba á los E. U.' (1848); 'Historia de la esclavitud desde dos tiempos mas remotos' (1876 et seq.); etc.

Saco, sã'kô, Maine, city in York County; on the Saco River, and on the Boston & Maine railroad; about 15 miles west-southwest of Portland and four miles from the ocean. Four bridges span the river connecting the city with Biddeford and other localities. A fall in the river of about 40 feet furnishes extensive water-power. The tide-water extends to the falls. The chief manufacturing establishments are cotton mills, boot and shoe factories, lumber mills, manufactories of belting, brushes, and cotton-mill machinery. The city has an extensive coast trade in cotton goods and other manufactures, and it ships considerable farm products. Old Orchard, a popular seaside resort, is in the vicinity. The principal public institutions are Thornton Academy; York Institute, founded in 1866; a public high school and elementary schools, two libraries, one home for the aged, several fine churches, and a number of good business blocks. Pop. (1890) 6,075; (1900) 6,122; (1910) 6,583.

Saco, a river which has its rise in the White Mountains in New Hampshire, and flows southeast through New Hampshire and Maine, and enters the Atlantic Ocean. It is about 165 miles long and drains an area of 1,750 square miles. It is a swiftly flowing stream having a number of rapids and falls, which furnish abundant water-power for manufacturing. Great Falls is 72 feet high.

Sacramentarians, a religious term which at present is applied almost solely to members of the Protestant Episcopal Church in America, and the Anglican Church in England and elsewhere, who sustain a "high" view of the efficacy of the sacraments. In past ecclesiastical history it has had a wholly different meaning, and was applied to those Reformers who refused to agree to Luther's doctrine of the real presence of the body and blood of Christ in the bread and wine. The Sacramentarian party were the authors of the Tetrapolitan Confession, so called from the four cities of Strasburg, Constance, Lindau, and Memmingen, which supported the Sacramentarian doctrines. This confession excluded all idea of a physical presence of Christ's body. The Swiss reformer Zwingli took a similar position on the question of Christ's presence in the Eucharist, and an article prepared by him declaring against the real presence was embodied in the confession of the Helvetic Church. The German Sacramentarians joined the general body of Protestants in resisting Charles V., and became merged with the Lutherans.

Sacramento, Cal., city, port of entry, county-seat of Sacramento County, and capital of the State, on the Sacramento River, and on the Southern P. and Central P. R.R.'s; 90 miles northeast of San Francisco. The city is situated in lat. 38° 33' N., and lon. 121° 20' W.; and is built on a broad, low plain, 30 feet above sea level. The streets are wide and straight and

cross each other at right angles. Shade trees are abundant. The shops and stores are built of brick and the dwellings mostly of wood. The city is noted for its beauty of environment, is the centre of an extensive agricultural and horticultural section; and has a warm, almost semi-tropical climate.

Public Buildings.—The State capitol building, completed in 1869, at a cost of \$2,500,000, stands in a plaza covering 30 acres. There is a United States government building here, the Crocker Art Gallery, building of the Foresters, Odd Fellows, and Masons, and Fort Sutter (re-built). California State Bank, Sacramento Institute, College of the Christian Brothers, California State Library (113,000 volumes), Public Library (28,000 volumes), Howe's Academy, Saint Joseph's Academy, City Dispensary, Railroad Hospital, and numerous churches, schools, and charitable institutions. The city has three daily newspapers and numerous weekly and monthly periodicals.

Manufactures.—Sacramento is the second manufacturing city in California, and has a variety of industries, including flouring and grist mills, foundries and machine shops, lumber mills, breweries, manufactories for saddlery, harness, furniture, carriage, soap, and crackers. The repair shops of the Southern Pacific railroad are located here, giving employment to 3,000 men. The industries of Sacramento represent a capital invested of \$7,300,013, with an annual output valued at \$11,141,896. The city exports immense quantities of flour and grist mill products, to China, Japan, and Australia.

Government.—The city is governed by a mayor and city council elected every two years by a popular vote. There are well equipped fire and police departments. The waterworks are owned and operated by the municipality. The assessed property valuation of the city is about \$18,000,000. The streets are lighted by electricity. An annual State fair is held here, and an exhibition building, park, and race course are maintained by the State Agricultural Society.

History.—The first white settlement on the site of Sacramento City was made in 1839, by Captain John A. Sutter, a Swiss by birth, but a naturalized American citizen, who obtained a grant of 11 square leagues of land from the Mexican government. In 1841 Captain Sutter built a fort which he called New Helvetia. He took many of the neighboring Indians into his service, collected a few white trappers, and by virtue of his isolated position and the number of his adherents, secured influence and importance in the territory. Sutter's Fort, as it was popularly called, was the first point in California settled by immigrants crossing the continent; with the increase of the population the trade and importance of New Helvetia kept apace, and in October 1848 there was an auction sale of lots in the town of "Sacramento," which was first named in the advertisement of the sale. In January 1849 the first frame house was built on the banks of the Sacramento River, and here the settlement was moved from the fort. The site of the town was originally only about 15 feet above low-water mark, and as the river frequently rose to 20 feet, the town was subjected to overflows. In January 1850, in March 1852, and again in January 1853, the city was flooded so

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that boats were used in going from house to house; after this the lower streets were raised five feet, and a levee was built which saved the city from subsequent floods. On 3 Nov. 1852 a conflagration destroyed 600 houses and other property, entailing a loss of \$5,000,000. In July 1854 another fire destroyed property valued at \$650,000. The State capital was established here by an act of the Legislature on 25 Feb. 1854, but not until 1861 was a capitol building erected. On 3 Feb. 1856, the first railroad was opened between Sacramento and Folsom. In the gold days of 1849-50 Sacramento was the great mart of the mines, the base of supplies and the metropolitan centre of various mining camps. Steamers ran daily to San Francisco and up the river to Red Bluff. The California Stage Company with a capitalization of \$1,000,000 ran daily stages to Maryville, Nevada, Downieville, Stockton, Jackson, Mokelumne Hill, and other leading towns in the mining district. The city was first incorporated as a town in 1849, and was chartered as a city in 1863.

Population.—Sacramento in 1860 had a population of 13,788; (1880) 21,420; (1890) 26,386; (1900) 29,282; (1910) 44,696.

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Sacramento, a river in California which rises in the northern part of the State, flows south in the valley between the Sierra Nevada and the Coast Range, and uniting with the San Joaquin River (q.v.); both break through the Coast Range, and enter the Suisun Bay, from which the waters pass through a strait into the Bay of San Pablo, and to the Pacific through San Francisco Bay and the Golden Gate. The chief tributaries are the Pitt River, from the northeastern part of the State, and Feather River, which enters the Sacramento about 15 miles above the city of Sacramento. The Sacramento is about 400 miles long, from the source of the Pitt to the mouth of the Sacramento is about 600 miles. The river is navigable for about 270 miles from its mouth, and the Feather River for about 30 miles from the Sacramento. The debris from placer mining has been a hindrance to navigation; large sums have been expended to improve navigation. The Sacramento Valley is a fertile region, in which are raised large quantities of grain and fruits.

Sacramento Salmon, Perch, Pike, etc., local names in California for various fishes caught in the Sacramento River, and more or less widely elsewhere. The salmon is the quinnat (q.v.). The Sacramento sturgeon is the white sturgeon (see STURGEON). The Sacramento perch is a fish (*Archoplitis interruptus*) closely related to the eastern rock-bass (see BASS). It reaches from one to two feet in length, is blackish above, sides silvery, with about seven vertical blackish bars, more or less interrupted. It is an excellent food-fish. The Sacramento pike is a big minnow (see SQUAW-FISH). The sucker is a species (*Catostomus occidentalis*) formerly of great importance to the Indian population, but little esteemed in civilized markets.

Sacraments. The Latin word *Sacramentum* was in the classical period a judicial and military technical term. The underlying concept seems to be consecration to a divinity,

something set apart for that purpose as sacred and inviolable. Thus the term was applied in jurisprudence to the specified sum of money deposited with the judicial authorities by the parties to a suit, and was so designated either because the place of deposit was sacred, or because the sum forfeited by the losing party was used for religious purposes. In military parlance the word signified originally the preliminary engagement entered into by newly enlisted recruits, and afterward the military oath of allegiance which became obligatory after the second Punic war (Liv. xxii. 38). Later on the term was used to designate any oath or solemn engagement whatever.

Among ecclesiastical writers the word has had various significations. In earlier usage, represented for instance, by the ancient Latin version of the Scriptures, and maintained even in many passages of the Vulgate (for example, Eph. v. 32, Rev. i. 20, etc.) it was a synonym of *arcanum*, and corresponded in sense to the Greek word *μυστήριον*, the notion embodied being that of something secret or mysterious, whence also, by extension, it came to denote the sign or symbol whereby hidden things were signified, especially in matters referring to religion. Thus Augustine says: "Symbols when pertaining to things divine are called sacraments." As certain religious rites of paganism were called mysteries on account of their occult signification known only to the initiated, the equivalent word "sacrament" was naturally adopted by the early Christians to designate their own religious rites and ceremonies, and was used at first more or less indiscriminately with reference to any or all of them. There seems to have been no attempt on the part of early Christian writers to define the sacraments accurately or enumerate them. Thus they speak vaguely now of two, now of more sacraments, at times even restricting the term to the Eucharist as *the* sacrament, and opposing it to Baptism. Nor do we find in their writings any definition of a sacrament more explicit than the rather general notion formulated by Augustine, "a sign of something sacred." In the literary treatment of this as well as other doctrinal topics analytic precision and systematic classification came gradually with the development of theological thought.

Roman Catholic theologians of the mediæval and subsequent periods understand by sacraments in the strict specific sense of the word, a definite category of sacred rites or symbols of divine institution, and which in virtue of this institution have the power of conferring instrumentally the grace or sanctity which they symbolically represent. Of these a certain number are allowed to have belonged to the Old Dispensation, being typical of the sacraments of the New Law, but the intrinsic efficiency attributed to them is limited (with however certain reserves in favor of the rite or circumcision taken to be the Old Testament type of Christian baptism) to the bestowal, not of internal, but external sanctity, that is, legal purifications, etc. With regard to the sacraments of the New Law, Roman Catholic theologians hold that they are seven in number instituted by Christ (namely, Baptism, Confirmation, Eucharist, Penance, Extreme Unction, Holy

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Orders, and Matrimony), and this enumeration, together with the main points of doctrine concerning the sacraments collectively and individually has been fixed by the dogmatic definitions of the Council of Trent.

The Reformers of the 16th century who professed to retain only such beliefs as were clearly demonstrable from Scripture, rejected the doctrine of the seven sacraments, but did not at once agree as to the number to be admitted, some recognizing besides Baptism and the Eucharist, Confirmation, Penance and Orders, while others rejected one or the other or all of these last. As regards the present status of opinion, if we except the High Church section of the Anglican communion, Protestant denominations as a rule, recognize only two sacraments: Baptism and the Eucharist.

That the existence of seven sacraments instituted by Christ cannot be proved from the New Testament alone must, of course, be granted, even by Roman Catholic theologians, but they claim that such proof is not necessary, since according to the fundamental Catholic contention, the New Testament writings do not furnish a complete record of Christ's actions—they are not, unless supplemented by tradition and the voice of the living Church, an adequate criterion of Christian belief and practice. They contend, moreover, that if the Scripture alone is to be held as decisive in the matter, consistency would require that the ceremony of the washing of the feet (John xiii.) be counted among the sacraments, since it seems to fulfil all the requisite conditions. (Sc. permanent divine institution, v. 4 seqq. cf. 12-18. Signification and production of grace, v. 8.)

Be that as it may, it must furthermore be conceded in connection with the appeal to tradition, that no positive proof of the recognition in the early church of seven sacraments neither less nor more, can be gathered from the writings of the Fathers. An explanation of this silence has been sought in the heretofore widely assumed influence of the so-called *Lex Arcani*, or Discipline of the Secret, whereby the early Christians were, it was claimed, bound to secrecy with regard to their beliefs and mysteries for fear of profanation on the part of the pagans. But apart from the obvious consideration that there could have been no sufficient reason to make a secret of the number seven, especially when we find that things so sacred as Baptism and the Eucharist are currently mentioned, the most competent authorities of the present day, Roman Catholic as well as Protestant, deny the existence of the *Lex Arcani* as a general prohibitive measure. As such it is chiefly a creation of the 17th and 18th century theologians (consult: Batiffol, 'Études d'Histoire et de Théologie Positive,' Paris, Lecoffre, 1902).^{*} Consequently, others endeavor to explain the silence of antiquity regarding the explicit mention of seven sacraments on the ground that no systematic, synthetic treatment of the subject was attempted by the early writers. Whatever may be the value of this consideration, it is certainly rather strange to find that so late as the 12th century Saint

Bernard enumerates no less than 12 sacraments. Roman Catholic theologians therefore rely chiefly on the so-called argument of prescription which is formulated as follows. At the time of the Reformation the entire Christian Church, East and West, was in peaceful, undisturbed possession of the doctrine of the seven sacraments. From the fact that then, as now, it was common to both the Greek and Latin Communions, is inferred that it must have been held in the Church at a period anterior to the separation of the Greeks in the 9th century. For apart from the antecedent improbability that any doctrinal growth peculiar to the Latin Church would have been adopted by her hostile rival, we do not find, as a matter of fact, that in the various discussions relative to the reunion of the two churches there was ever any difference to be adjusted relative to the number of the sacraments, though matters of seemingly less consequence were often made the object of protracted dispute. A similar line of argument, though less cogent, is pursued with reference to the Oriental sects—Nestorians and Monophysites—who separated from the Church in the 5th century. Whence, it is argued: if this doctrine was that of the Christian Church in the 5th century, it cannot be of other than apostolic origin, for the spirit of the early Church was hostile to all doctrinal innovations, as is proved by the history of the great controversies, and she would doubtless have resented any alteration of the original belief in a matter so important and of such a practical character as that referring to the number of the sacraments. It will be noticed that this argument is partly *a priori*, involving the contested assumption, that with regard to the point at issue it was impossible for the Church to have undergone any change of belief.

In the synthesis of theological speculation elaborated by the scholastics, the sacramental system was conceived as an extended application and a consistent carrying out of the great principle embodied in the Incarnation. In this mystery, according to the belief of most Christians, the invisible Godhead, the author of life and grace, was made flesh and dwelt among us, imparting to men through his tangible, human life and ministry that life of the spirit without which salvation is impossible. Hence the idea of conferring and developing the spiritual life through the instrumentality of visible material things ordained to that purpose was recognized as a principle underlying the entire economy of external means of grace in the Church. As regards the seven sacraments the theory is thus systematically worked out in the theology of Thomas Aquinas (1226-74). There is an analogy between the natural and the spiritual life in man. In the natural order man is born; he attains strength and maturity through growth; he is nourished by food; should illness occur he needs medicine; the common good requires the propagation of the race, and the supervision of legitimate authority; and finally, man needs to be prepared for his departure from this world. Now the parallel needs in the spiritual order are provided for through the seven sacraments. Thus, man is born in baptism, strengthened in confirmation, nourished by the Eucharist, and cured

^{*}For a well meant but quite ineffectual defense of the old view concerning the Discipline of the Secret, consult McDonald, 'The Apostles' Creed.'

from illness by penance; the Christian Church is propagated through matrimony, and by holy orders proper guides are provided in things spiritual; and lastly by extreme unction the believer is prepared for his passage into eternity.

While this comparison is ingenious, and instructive as a part of a logical coherent system, it cannot, of course, be adduced as a proof that there are precisely seven sacraments, for obviously it was excogitated to fit the case, and had the number of sacraments then admitted been six or eight or more, the analogy would doubtless have been worked out just as satisfactorily. It proves at most that in the 13th century the doctrine of the seven sacraments had been definitely recognized. As regards the effects of the sacraments, it may be remarked that Catholic theology claims for three of them (Baptism, Confirmation, and Orders), besides the conferring of grace common to all, the impression upon the soul of an indelible mark or "character." This effect is produced even when through a lack of disposition on the part of the subject no grace is bestowed, whence these three sacraments, when validly administered, are never repeated. If sometimes in the case of baptized converts, baptism is again administered conditionally, it is only on account of some doubt as to the validity of the rite previously conferred. The proof for the existence of this "character," which Protestants unanimously reject, is based chiefly on the ancient practice of the Church with regard to the non-repetition of these sacraments, and on certain texts from the works of early writers who express more or less vaguely the doctrine formulated later on by the theologians and the Council of Trent.

The views of the early Reformers concerning the mode of efficiency proper to the sacraments were, no less than those concerning their number, a radical departure from the received Catholic doctrine. According to the latter the sacraments produce their effects *ex opere operato*, by which formula is meant, that whenever the rite is properly administered and no obstacle or indisposition exists on the part of the subject, saving grace is imparted to the soul, by virtue of the rite itself as an instrumental cause, and independently of the dispositions of the minister or subject—at least so far as the essential effect is concerned. This mode of efficiency is sometimes expressed by saying that the sacraments contain the grace which they signify. Not that grace can be inherent in the physical symbols, but that through a divine ordinance it is infallibly connected with their administration.

While Protestant authorities are generally agreed in rejecting this doctrine, there is among them much divergence of opinion when it is a question of determining the nature of sacramental causality. Thus according to the Zwinglian and Remonstrant doctrine the sacraments are not properly a means of grace. "They were not ordained to signify, seal, and apply to believers the benefits of Christ's Redemption, but simply to be significant emblems of the great truths of the Gospel." The Reformed Church holds the sacraments to be a means whereby grace is conferred, but "their efficacy is due solely to the blessing of Christ and the working of His

Spirit, and this efficacy is experienced only by believers." According to the Lutherans the sacraments confer grace in virtue of their own inherent power, but their efficacy resembles that of a sermon; it can act with saving effect only upon believers, and the beneficial efficiency of the rite consists chiefly in animating the faith of the receiver and strengthening his confidence in the divine promises.

To substantiate the *ex opere operato* or direct, independent causality, Roman Catholic theologians adduce certain passages of the New Testament referring to sacramental efficiency, and in which the saving effect is attributed directly to the rite itself as the secondary instrumental cause. Thus in John iii. 5 spiritual regeneration is expressed as a birth of water and the spirit. Similarly Paul asserts that we have been saved "through the washing of regeneration" (Tit. iii. 5) and he admonishes Timothy to stir up the gift of God which is in him through the laying on of hands.

Another argument is based on the very ancient custom of infant baptism, one that was retained by several of the Protestant denominations. If infants are really born again to a new life by means of the ceremony of Baptism, we can scarcely conceive such an effect otherwise than as due to the immediate efficiency of the rite itself. Obviously it is not because the faith of the subject has been stimulated. Neither can the faith of the minister be the efficient cause, since, apart from other reasons, the Church has always maintained the validity of Baptism even when conferred by heretics and schismatics—the sacramental rite when properly administered was supposed to possess its own efficiency.

Consistently with this view it has been the constant teaching of the Church ever since the controversy between Pope Stephen and Cyprian in the 3d century, that neither faith nor righteousness is required in the minister of the sacraments for their valid administration. A certain intention, however, is postulated, namely, that of doing what the Church intends to effect by the rite in question. In other words, it is required that the minister intend to perform the rite not in his own name, but, implicitly at least, as a representative of Christ and of the Church. This intention can be extremely vague—in fact, reduced to a minimum—provided the effect intended by the Church be not positively excluded. As is well known, this question of the requisite intention is one of the main points at issue in the controversy concerning the validity of Anglican orders.

Other questions pertaining to the sacraments are of less importance and belong rather to a complete detailed treatment of the subject as found in the ordinary handbooks of theology.

Consult: Hodge, 'Systematic Theology,' Vol. III. (Protestant); Wilhelm and Scannell, 'A Manual of Catholic Theology,' Vol. II. (R. C.). See BAPTISM; CONFIRMATION; EUCHARIST; etc.

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Sacred Heart, Brothers of the. See ORDERS, RELIGIOUS.

Sacred Heart, Ladies of the. See ORDERS, RELIGIOUS.

SACRED HEART — SACRIFICE

Sacred Heart, League of, or Apostleship of Prayer in League with the Sacred Heart of Jesus, a pious association whose object, the glory of God and the salvation of souls, is expressed by its motto, "Thy Kingdom Come." The association was founded at Vals, France, on 3 Dec. 1844, the feast of Saint Francis Xavier, by Father Francis Xavier Gautrelet. The director-general of the League is the father-general of the Society of Jesus, and the principal seat or centre of the association is established at Toulouse. There are also diocesan directors and local directors for every centre. Promoters, who assist in extending the work of the association, are appointed by the local directors. The names and addresses of all the members of the association are kept on record. The number is so great in many centres that the card catalogue system is used. The number of local centres in the world, in October 1903, was 60,904, and in these centres there were registered over 20,000,000 associates or members. The directors of these 60,904 local centres are in communication through their diocesan directors and 37 periodicals, called 'Messengers of the Sacred Heart,' with the general director now (1904) living at Tournai, Belgium. The 'Messenger of the Sacred Heart' is published in 22 languages; 6 of the 37 are in English and 6 in Spanish. Other languages in which it is published are German, French, Albanian, Breton, Bohemian, Chinese, Catalanian, Croatian, Flemish, Dutch, Hungarian, Italian, Malabar, Indian, Polish, Portuguese, Slavonic, Hindustani, Arabian, and Greek. In January 1904, there were about 5,000,000 members in the United States. In addition to the league periodicals, another most important means of communication are the leaflets distributed each month by the promoters to all the members. The leaflets give the "General Intention" for which all are to pray and work during the month, and supplement the 'Messenger' in suggesting ways and means of uniting with the efforts of the missionaries throughout the world for the conversion of souls. Consult: 'Handbook of the Apostleship of Prayer'; 'Messenger of the Sacred Heart' (magazine, February 1904, New York); Ramière, 'Apostleship of Prayer.'

Sacred Heart of Jesus, Feast of the, a feast celebrated by the Roman Catholic Church the first Friday after the feast of Corpus Christi. This feast originated in the latter part of the 17th century, as the special and formal devotion to the Heart of Jesus, owes its origin to Margaret Mary Alacoque, a French nun of the Visitation Order. Her biographers relate that the Lord Himself appeared to her and gave her instructions regarding the devotion. Many in the Church had practised devotion to the Sacred Heart of Jesus from the time of the Crucifixion, as Cyril, Cyprian, Tertullian, Basil, Ambrose, Saint Francis of Assisi, and others, but the devotion was not general nor popularly advocated until the time of Margaret Mary Alacoque. Consult: Gallifet, 'The Adorable Heart of Jesus'; Tickell, 'Life of Blessed Margaret Mary Alacoque'; Nilles, 'De Rationibus Festorum Sacratissimi Cordis Jesu et Purissimi Cordis Mariæ.'

Sacred Monkey, any of several apes, monkeys and baboons regarded as venerable by bar-

barous people in various periods and regions. See APE; BABOON; HANUMAN; LANGUR; etc.

Sacred Order of Siam, The. See ORDERS, ROYAL.

Sacred Treasure, Order of the. See ORDERS, ROYAL.

Sac'rifice, the offering of anything to God or to a god; also the thing so offered. Sacrifice is common to all religions. In the lowest state of inculture the sacrifice is an offering of some article of food to the god, who is believed actually to eat the flesh of the victim or the fruits of the earth, which his worshippers deposit at his customary haunts—in some cave, at some fountain, or some sacred tree. But more usually a sacrifice is a feast of which the god and his worshippers both partake. In the best times of the Roman commonwealth this idea of a meal common to the gods and men had recognition in every household; for the Roman family never rose from table at the end of the principal daily meal till a portion of the food had been consumed on the hearth as an offering to the household gods. Of like significance is the fact that the slaughter of an animal for food and the offering of one in sacrifice are expressed by the same word in Hebrew; and that the Arabians pronounce over every animal they slaughter for food the name of Allah. In all sacrifices, whether of the pagan nations or of the people of Israel, certain portions of the victim were reserved for the deity—the blood, the fat, the head, shoulders, viscera, etc.; the rest was eaten by the worshippers. Usually the portions reserved for the god were consumed by fire, whereby, for the imagination of primitive peoples, the material offerings were etherialized, ascending to heaven in savory clouds of smoke and vapor. In many religions, too, as in that of Egypt, certain sacred animals are regarded as related to the tribal god, and as such are reserved wholly for sacrificial uses. The object of the sacrificial feast is always to renew and strengthen the ties of kinship and friendship between the god and his worshippers, and so to secure the continuance of material prosperity. This primitive sacrificial system is not without religious value; at least it is genuine; the ideas which it embodies are for every worshipper realities. And it has considerable ethical value, too, as binding the worshippers not only to the god, but to one another. The goods it seeks are material, but they are always public and social; it gives the individual no place except as a member of the tribe or gens. A new and radically different conception of sacrifice is formed when the tribal system begins to break up. Before a sacrifice can now take place an animal has first to be surrendered by its owner and consecrated. Dedication takes the place of natural sanctity. It is this new and important element that changes the character of sacrifice. The act of surrender, which is at first a mere preliminary, comes to be regarded as the essential feature. A sacrifice begins to be spoken of as a gift or tribute from the worshipper to the deity, and the original sacramental idea is gradually lost sight of. Is this a forward or a backward movement of thought? Two interpretations are possible. If the sacrificial gift is simply an expression of the truth that all private property is

SACRILEGE — SACY

a trust from God and ought to be devoted to His service, the new conception is an advance and can do nothing but good. But if it be supposed that God stands in need of gifts, and that the more numerous and costly the oblations the greater their efficacy, the tribute-idea is a backward movement. Sacrifice then becomes nothing but a method of conjuring. The historical outcome of the gift or tribute theory is holocausts, hecatombs, and human sacrifices. These last are a strange instance of reversion to barbaric practice. Human sacrifice is natural among cannibals; the food that is most grateful to man is always presented to the gods. Its revival among civilized peoples is the result of a very different train of thought. Those who begin to measure the atoning power of a sacrifice by its magnitude, splendor, or cost cannot forget that they have possessions more precious than flocks and herds. Hence in times of great distress they begin to conjure the displeasure of their gods with offerings of their own flesh and blood.

In primitive Israel the central feature of sacrifice is always the common meal, provided for by the slaughter of the sacred animal and by various kinds of cereal oblation. Time gradually robs the meal of its sacred character, and then the holocaust becomes common. After the exile the great sacrifice is the sin-offering, which culminates in the solemn ritual of the day of atonement. It is generally supposed that the central idea of the sin-offering is that of substitution — Jehovah accepting the life of the victim for that of the sinner. That is probably a mistake. Just as in the earlier sacrificial meal, so here, the significant part of the rite is not the shedding, but the application of the life blood, followed by the burning of certain portions of the flesh and eating of others.

The thinkers of Greece and the prophets of Israel wage a constant polemic against the popular superstitions connected with the sacrificial system. Some of the latter seem to break away entirely from ritual, others do much to give it an ethical and spiritual meaning. Christianity embraces whatever is true both in the sacramental and in the dedicatory idea of sacrifice. The former idea receives its perfect expression in the first Christian rite, the latter in the first rule of Christian ethics, which transfigures sacrifice into self-sacrifice. But the followers of Christ are slow to rise to the height of His teaching. Material sacrifice is always easier than spiritual. See OFFERINGS AND SACRIFICES.

Sac'rilege, the act of violating or profaning any sacred thing or any place that has been dedicated to the service of God, as a church or a chapel; in popular usage it means breaking into a place of worship and stealing therefrom. Another meaning of sacrilege is the alienating to laymen or to common uses, of what has been dedicated, appropriated or consecrated to religious persons or purposes; as thus understood, sacrilege is an offense triable by ecclesiastical courts. In the Roman law robbery of churches was, under the Justinian Code, punishable with death. It was formerly a capital crime in English common law also, but by the statutes 24 and 25 Victoria burglary of churches is treated simply as burglary, and theft of sacred things from sacred places as larceny. Neither in the stat-

utes of the United States nor in those of any of the individual States of the Union is sacrilege treated as a crime in any way different from common burglary or larceny. Consult: Spellman, 'The History and Fate of Sacrilege.'

Sac'ristan, the original of the name 'sexton,' which is an abbreviation of sacristan, the former title being still retained in some churches. The sacristan is an officer in a church whose duty it is to take care of the church and all belonging to it, the sacred vestments and utensils, etc., and prepare whatever may be required for the sacred offices.

Sacristy, in the ancient Church a building attached to the basilica and consisting of three parts: (1) The reception room, in which the bishop was received by the clergy and also gave audiences. It was in this room at Milan that the Emperor Theodosius asked absolution of Saint Ambrose. (2) The sacristy proper in which the sacred vessels and vestments were kept for immediate use; here the officiating ministers robed themselves for divine service. (3) The chamber in which office books, vestments, and church plate not in present use were kept. In many modern churches the sacristy is called the vestry, and consists of but one room.

Sacrobosco, sāk-rō-bōs'kō, **Joannes de** (John of Holybush, Holywood, or Halifax), English mathematician and astronomer: b. Halifax, Yorkshire; d. Paris 1256. He entered the University of Paris in 1221, afterward becoming a professor there. His most celebrated work is a treatise, 'De Sphæra Mundi,' a paraphrase of a portion of the *Almagest* (q.v.), of Ptolemy (q.v.). It was printed in 1472, and was afterward frequently reprinted, with the additions of able mathematicians. He was also the author of a treatise, 'De Ratione Anni, seu de Computo Ecclesiastico'; a work on arithmetic, bearing the title 'De Algorismo,' which is one of the earliest treatises on the subject in which the Arabic numerals are used. It was printed at Paris in 1498, with the 'Commentary of Petrus Cirvillus.'

Sac'rum, the sacred bone (*os sacrum*), a compound triangular bone situated at the lower part of the vertebral column (of which it is a natural continuation), and wedged between the two innominate bones so as to form the keystone to the pelvic arch. In man it consists of several vertebrae with their bodies and processes consolidated into a single bone. Its anterior surface is concave from above downward and from side to side. The posterior surface is convex, and presents in the middle vertical line a crest, formed by the fusion of the spines of the vertebrae, of which the bone is composed. The last sacral vertebra has, however, no spine, and the termination of the vertebral canal is here very slightly protected. In the female the sacrum is broader than in the male. The sacrum of man differs from that of the lower animals by its greater breadth in comparison with its length. See ANATOMY; OSTEOLOGY; PELVIS; SPINE.

Sacy, sā-sē, **Antoine Isaac, BARON SILVETRE DE**, French Orientalist: b. Paris 21 Sept. 1758; d. there 21 Feb. 1838. Obtaining a thorough acquaintance with the Greek and Latin classics, he studied Hebrew, Syriac, Chaldean,

Samaritan, and then Arabic and Ethiopic. To these he added a knowledge of the principal European languages, including Turkish. Later he mastered Persian. During the Revolution he withdrew to a short distance from Paris, and lived unmolested, though his attachment to monarchy was well known. In 1795, when the Convention established a school of Oriental languages, De Sacy was appointed professor of Arabic, and was allowed to retain this situation notwithstanding his refusal to take the oath to the new constitution. Bonaparte made him professor of Persian in the College of France (1806), and afterward bestowed upon him the title of baron (1813). In 1808 he was elected by the department of the Seine into the legislative body; but took no part in the debates till 1814, when he voted for Napoleon's deposition. In 1815 he was appointed rector of the University of Paris, and shortly after member of the commission for public education. While officiating in these capacities he formed around him a circle of scholars, by which he became indirectly the teacher of all Europe. He took a prominent part in founding (1822) the Asiatic Society of Paris, of which he was president; and it was by his recommendation that professorships of Chinese, Sanskrit, Manchu, and Hindustani were established in the capital. In 1832 Louis Philippe raised him to the peerage and made him, after Remusat's death, which took place in this year, conservator of the Oriental MSS. in the royal library. Among his works may be mentioned: '*Principes de Grammaire générale*' (1799); '*Grammaire Arabe*' (1810); and '*Chrestomathie Arabe*' (1806); '*Exposé de la Religion des Druses*' (1838); '*Calila et Dimna*' (1816).

Saddle, a seat for a horse's back, contrived for the safety and comfort of the rider. In early ages the rider sat on the bare back of his horse, but in course of time some kind of covering was placed over the back of the animal. The modern riding saddle consists of the tree, generally of beech, the seat, the skirts, and the flaps, of tanned pig's skin, and the construction and weight vary according to the purposes for which it is to be used. Among the varieties are racing saddles, military saddles, hunting saddles, and side saddles for ladies. The name saddle is also given to a part of the harness of an animal yoked to a vehicle, being generally a padded structure by means of which the shafts are directly or indirectly supported.

Sad'dlerock Oyster, a large and favorite kind of oyster originally obtained from a reef known as Saddle Rock near Norwalk Harbor, Connecticut. The supply was exhausted early in the last century, but in the first attempts at artificial cultivation of oysters (q.v.) in the eastern part of Long Island Sound many small "seed-oysters" were derived from that district, and so the name continued until it became a market term about New York for large and well-shaped oysters mostly sold to be eaten raw.

Sadducees, sād'ū-sēz, a sect of the Jews well known in religious history on account of being mentioned in the New Testament. Beyond their name, however, very little is known regarding them. Even the origin of their name is undecided, though there seems plausibility in the argument that it is derived from the high-

priest Zadok, who anointed Solomon as the successor of David, and whose descendants appear to have been prominent many ages after in the Jewish community. It is conjectured that the Sadducees may have been members and adherents of the house of Zadok. The Sadducees denied that the oral law, handed down by tradition as the utterances of Moses, had equal authority with the written law, and they rejected the doctrine of the resurrection, and also denied, according to the New Testament, the existence of angels and spirits. According to Josephus the Sadducees also disbelieved that there was such a thing as fate, whereas the Pharisees, the other great Jewish sect, while not denying nor questioning liberty of will, held that all actions and events were fixed by unalterable decree. The Sadducees seem to have disappeared as a separate body after the first century of the Christian era, although an existing Jewish sect, the Karaites, agrees with them in the rejection of oral law. See JEWISH SECTS.

Sadhs, sads, or Saadhs, sā'āds, a Hindu sect which believes in one God, and teaches a pure morality. The sect was founded 1658 A.D. by a man called Birbhan. They have no temples, but assemble at stated periods in houses, or courts adjoining to them. They are found chiefly in Farukhabad, Delhi, Mirzapore, etc.

Sadi, sā-dē', or Saadi (MOSLEHEDIN SHIRAZI), Persian poet: b. Shiraz about 1184; d. there 1291 or 1292. After completing his studies and spending many years in travel, he settled in the neighborhood of Shiraz, where he enjoyed the favor of several Persian rulers. The Persians esteemed him exceedingly on account of his golden maxims, which they consider as a treasure of true wisdom; and also on account of his pure, elegant, and simple style. Of his works (1) a collection (*Divan*) of lyric poems in the Arabic and Persian languages; (2) '*Gulistan*' ('*Garden of Roses*'), a didactic work composed both of prose and verse, in eight books; (3) a work in verse, called '*Bustan*' ('*The Orchard*'), containing a collection of histories, fables, and moral instructions. The complete works of Sadi were published in Persian at Calcutta (1791-5). Graf has published translations from the '*Divan*' in the '*Zeitschrift der morgenländischen Gesellschaft*,' and there is a German translation of the political poems by Rückert (with life of Sadi, 1894). There are editions of the '*Gulistan*' by Sprenger (1851) and others, and among English translations are those by Eastwick (1880) and Ross (1823). The '*Bustan*' has been edited by Graf (1858) and Rogers (1801), and translated into English by Davies (1883), and in part by Sir Edwin Arnold ('*With Saadi in the Garden*,' 1888). Consult Ouseley, '*Biographical Notices of Persian Poets*' (1846).

Sadi-Carnot, sā-dē kār-nō. See CARNOT.

Sadler, sād'lér, Anna Teresa, Canadian writer: b. Montreal, P. Q., 1856. She has written much for the Roman Catholic press, and her published books include: '*Ethel Hamilton, and Other Tales*' (1877); '*The King's Page*' (1877); '*Seven Years and Mair*' (1878); '*Women of Catholicity*' (1885); '*The Silent Woman of Aloud*' (1887); '*Gems of Catholic Thought*,' compilation (1882); etc.

Sadler, or Sadleir, Sir Ralph, English diplomatist: b. Hackney 1507; d. Standon, Hertfordshire, 30 Marsh 1587. He became the ward of Thomas Cromwell, was one of Henry VIII.'s principal secretaries of state, and was appointed by Henry's will one of the council to assist the executors upon whom was laid the government of the country and the guardianship of young Edward VI. He went into retirement during Mary's reign, but emerged after the accession of Elizabeth, and became one of Cecil's agents, especially charged with negotiating Scottish affairs. In 1568 he became chancellor of the duchy of Lancaster and thereafter he was mainly occupied as one of the English commissioners to treat of matters relating to the Queen of Scots. In 1580 he was for a time one of her guardians at Sheffield and Wingfield. His last mission was to James VI. of Scotland in 1587 to endeavor to reconcile him to the execution of his mother. Consult Sadler's State Papers, with memoir and historical notes by Sir Walter Scott (1809).

Sadler, Reinhold, American legislator: b. Prussia 10 Jan. 1848. He came to the United States when young, and has been for many years a resident of Nevada. He was elected lieutenant-governor of Nevada in 1895, and on the death of Governor Jones in 1896 became governor. He was regularly elected to the office in 1898, which he occupied until 1903.

Sadler, Walter Dendy, English painter: b. Dorking, Surrey, 12 May 1854. He studied art in London and Düsseldorf, and has exhibited at the Royal Academy since 1873. Among his best known pictures are: 'Thursday'; 'Darby and Joan'; 'The Widow's Birthday'; 'The New Will'; and 'For Weal or Woe.'

Sado, sã'dõ, Japan, an island off the west coast of Hondo, opposite and 32 miles from Nügata, with an area of 336 square miles, and a coast line of 135 miles. It has a diversified surface culminating in Kimpokusan, 3,820 feet high. South of Kimpokusan is the town of Aikawa, near the east coast, with the ancient and still productive gold and silver mines in its vicinity, to which Sado owes its celebrity. On the west coast 18 miles distant from Aikawa is Ebisuminato, the port of the island. Pop. of island 113,000.

Sadoletto, sã-dõ-lã'tõ, Jacopo, Italian theologian: b. Modena 1477; d. Rome 18 Oct. 1547. He was consecrated bishop of Carpentras, near Avignon, in 1517; belonged to the Contarini Reform Party, and was a member of the commission appointed by Paul III. to take steps toward effecting a church reformation. He immediately opened a correspondence with Erasmus, Bucer, Sturm, and Melancthon, but when in 1539 he invited the Genevans to return to the Roman Catholic Church, he received a harsh rebuff from Calvin. After that he confined himself largely to his own diocese. He had been appointed cardinal in 1536, but while he was frequently summoned to Rome he preferred Carpentras, and his study well stocked with books of the new learning, in which he was an adept, being one of the best Latinists of his day. He wrote commentaries on the Psalms, and on the Epistles of Saint Paul, and so excellent was their style that Erasmus made the somewhat invidious remark

that "their very polish of expression will take off the edge of their pious suggestiveness." His works were published in four volumes in 1734. He was a diplomat in whom successive popes had confidence and acted as ambassador to Francis I. in the interests of peace in 1544. Consult Joly, 'Etude sur J. Sadolet' (1856).

Sadowa, sã'dõ-vã (Czech *Sádová*), Austria, in Bohemia, near Königgrätz, on the Bistritz, a village remarkable as one of the hotly contested Prussian positions in the decisive battle of 3 July 1866, in which the crown prince of Prussia and Prince Frederick Charles commanding the Prussians, defeated the Austrian forces under Benedek. This battle is known also as the battle of Königgrätz.

Sæmund (sã'moond) the Wise, Icelandic scholar: b. Iceland about 1155; d. Oddi 1233. He undertook a course of foreign travel in pursuit of learning, and visited Paris and Rome; then, returning to Iceland, he became priest at Oddi (1176). He was unknown to scholars till about 1643, when the newly discovered 'Elder Edda' and other writings were falsely ascribed to him.

Safe, a receptacle for money, important papers, and valuables, usually of iron or steel, or of both combined. A safe, to justify its name, should be proof against fire, explosives, acids, drills, wedges, and the other implements and opening devices resorted to by burglars. The history of safe-making is mainly a record of struggles between the burglar and the safe-manufacturer; the result is, that safes can now be obtained which are all but impregnable. With the modern safe of the best kind the lock may be said to be the only vulnerable point; hence much care and ingenuity have been expended on its mechanism. Numerous patents, mostly of American origin, have been introduced in recent years. Of these, the keyless permutation locks deserve particular mention, as they obviate the danger which arises from lost or false keys. Such locks allow of opening only after an indicator has been moved in accordance with a certain combination of numbers arranged before closing the safe. Some safe-locks are so constructed that to be freed they require different keys on different days, some can only be opened at a certain hour, this being fixed on before the door is closed; while others again require two or more keys in charge of different persons; in fact, the arrangements contrived to render the plundering of safes next to impossible are too numerous even to mention. The connection of safes with electric alarms in a variety of ways forms another safeguard.

Safe-conduct, a security granted by the sovereign authority, or persons delegated by it, to strangers or other persons to enable them to repair to and return from a certain place undisturbed. In most of these cases passports have now taken the place of special safe-conducts. Sometimes the safe-conduct is given to persons accused, to secure them against harm when summoned to an examination.

Safe Industry in America. Various methods for the safe-keeping of treasure, jewels and other valuables have been in use since the earliest periods in history, and the advancement in this line has necessarily kept

apace of the times, the increase in the volume of wealth throughout the world of course rendering it imperative that more improved facilities for guarding this accumulated wealth be put into use. Thus we have witnessed the evolution from the old-fashioned strong-box to the massive chilled-iron and steel vaults, absolutely fire-proof and burglar-proof, till they have reached the highest degree of efficiency and perfection that science and skill can make them. Locks of rude construction were in use by the ancient Egyptians, and during the Middle Ages by the Romans. The Chinese also used a lock similar in construction to the famous Bramah lock, invented in England in 1784. These were made of wood, the tumblers being of different lengths to fit the sizes of the wards in the keys. Beginning with the Middle Ages the inventive genius of man was turned toward providing something more substantial than a lock as a method of warding off the burglar, who at that time had not attained to the remarkable skill and cunning of the modern "cracksman," and indeed the professional thief of modern times would look back with envy on his predecessor who had nothing more than a mere wooden box, sometimes bound with iron, with which to cope. The first means of securing valuables was by placing them in some secret cavity in a wall, the door of which was opened by a spring or other device, but more often articles of household furniture were used, such as desks with secret drawers, or tables and chairs with false bottoms. These constituted the chests of the wealthy for some time and some of them were furnished with locks and bound with strips of iron, the whole very artistically made so as to ward off suspicion of their contents. The oaken-chest or strong-box, reinforced with iron bands and knees, was in the beginning of the 18th century considered to be the best means of security. Such a chest was used in 1707 to guard the crown jewels of Scotland, but when they were to be examined by the Royal Commissioners, the locks of the chest had to be broken and the lid forced up because there was no other manner in which the chest could be opened, an operation which the modern blacksmith would consider an easy task to perform.

Prior to the beginning of the 19th century practically no attempt was made to make these strong-boxes of a material which would withstand heat or which would in any way render them impervious to the ravages of fire. The first improvement along this line was made in France about 1820, the safes then constructed consisting of a metal box built within double walls, the space between being filled with a composition of non-conducting substances. A little later a so-called fire-proof safe was constructed in New England, considered to be a vast improvement over the existing types. This safe had a body of solid oak plank from three to four inches thick, which, after being thoroughly saturated with an alkali, was covered with sheets of thin iron. To make this more surely fire-proof bands of iron were crossed and recrossed over these plates and nailed down with large round-headed iron spikes,

the whole affair being a very gruesome and formidable looking object. The great fire in New York in 1835 proved the worthlessness of these, several hundred of them being then destroyed. The idea of filling in the walls of a safe with a nonconducting substance was first put into use in this country in 1843 by Daniel Fitzgerald. His idea was to fill the walls of the safe with plaster of paris because of its tendency to throw off heat, and having secured a patent on his invention he immediately began to manufacture a safe known as the "Salamander." His patent was later assigned to B. J. Wildey, who made a safe called "Wildey's Patent," the principle of these being to leave the space between the walls empty, trusting that the contents of the inner portion of the safe would be protected from heat by the nonconducting properties of the air. Other mixtures such as asbestos, mixed with plaster of paris, clay, alum, fire-clay, mica, chalk, etc., were then used to fill the vacant space but none of these have proven absolutely safe. To-day the modern safe is filled either with a substance, alum or some other salt, which when heated gives off a quantity of water; or by placing in the walls a receptacle, either glass or metal, containing water so as to give off steam when the outside walls become overheated. The idea of using steam as a nonconductor originated with Prof. A. K. Eaton, of New York, who learned by experiment that the contents of a safe could not be injured by fire so long as steam at 212° F. surrounded the inner chamber, but the main objection to the use of water as a nonconductor lay in the fact that this subjected the contents of the safe to constant dampness. The use of substances which contain water in their chemical composition has, however, largely done away with this objection.

Outside of the fire element, the most important part of the safe to be considered is the lock, for with our modern methods of fire protection the danger of burglary is more imminent than the loss by fire. The first supposedly nonpickable lock was the Bramah, but this was finally proven to be valueless and easily picked, this being done in 1851 by a Mr. Hobbs, by the "tentative process." Three other locks then came into use, the Chubb, also picked by Mr. Hobbs, the Pye lock, invented in 1851, but picked by Linus Yale, Jr., of Philadelphia, by the "impression process," and the Yale lock. Since then many new forms of locks have been invented, and the modern lock-combinations are constructed in a manner which has made the trade of burglary extremely difficult while they are otherwise absolutely fire-proof. There are three ways of procuring security against burglary, first, by the laminated construction; second, by the use of blocks of chilled iron, this method being more useful in the construction of large vaults than in the making of portable safes; and third, by the spherical chilled-iron safe. In the first method of construction the chamber is made of alternate layers of hard and soft plates of iron and of plates of hardened steel, the two laid alternately over each other in the walls of the chamber in such a way that they form a single mass. Thus the

body of the safe being constructed of alternate plates of iron, welded iron and steel, carbonized and decarbonized steel, and crystal steel, fastened together by means of bolts from the inside has made safes practically impregnable to the appliances used by the modern burglar, such as sledge-hammers, jimmies, jackscrews and other devices. Another method of making safes, in common use by manufacturers, is to roll down together while hot into one solid sheet of tempered steel three layers of soft iron or steel alternated with two intermediate layers of hard steel. These composite sheets, when they have been rolled till about one-half of an inch thick, are then built into the walls of the safe and alternated with plates of heavy steel about one-half inch thick. The doors are generally the weak point in the construction of a safe, for it is these which a burglar first attacks to see if there is any crevice into which a wedge might be inserted, or any crack into which nitro-glycerine or any other high explosive might be introduced. In some safes the plates comprising the door are dovetailed, engaging with the corresponding parts of the jamb; in some an air-tight packing is used between the jambs and their abutments; while in others a screw door is used.

One solid mass of metal is used in the second and third types of safes, the tough and hard qualities of the metal being obtained by modification. The metal used is a soft, malleable iron, the surface of which can be hardened by cooling. In the construction of many vaults, blocks of this "chilled-iron," weighing from three-quarters to several tons, are bolted together on the inside, the sides being dovetailed together, and the outside surface is chilled to the highest degree of hardness. The door is a single casting of iron, two inches thick, and also chilled on the outside.

In the third type, the spherical, invented by William Corliss, the shell, constructed of steel from four to seven inches thick and chilled to a depth of about two inches, sometimes contains a "bugging" made from Franklinite ore found in Sussex County, N. J. This material, which possesses a hardness exceeding that of the best tempered steel, and is in appearance somewhat like crystallized silver, is so interwoven with wrought-iron rods that it can be battered with the greatest degree of force but will only bend, not break. The purpose of this construction of wrought and crystallized iron is to hamper a burglar in his work, it being supposed that in an attempt to drill through the walls of the safe, the drill will penetrate the soft metal more readily than the hard, and, consequently, working sideways, will be broken off when it strikes the hard metal. The "bugging" may, however, be used in precisely the opposite manner, the rods being made of the hardest tool-steel and the body of the filling composed of cast-iron segments, but the principle of turning the point of the "cracksman's" drill is the same.

In our large banks and safe-deposit vaults there is no room sufficiently large to contain the number of individual safes which would

be required to hold the enormous masses of money and other valuable securities with which these institutions are intrusted. This has turned the attention of the manufacturer in recent years to the building of large vaults which would be absolutely fire and burglar-proof. The interior of these vaults may be constructed to suit the tastes and requirements of the owner, but the walls are now made much thicker than formerly and the builder has made more use of fire-proofing materials. The most important feature of the modern vault is the lock, which has now reached the acme of perfection. The first form of lock used was the combination-lock, an outgrowth of the "tumbler" lock, and the mechanism of these is very ingenious. These locks are not limited in the number of combinations upon which they may be set, and may be changed at any time should the combination become known to undesirable persons. The most valuable asset of the modern vault, however, is the chronometer, or time-lock, the mechanism of which is as intricate and as complicated as the best watch but at the same time it runs as true and as smoothly. To offset any possible disarrangement in the mechanism of a single clock, which would, of course, prevent the opening of the safe, three movements are usually inclosed in a single case. As these safes cannot be opened by any human agency until the time set for the clock to operate the mechanism which swings back the ponderous doors, it is obvious that the chronometer combination is the greatest safeguard against robbery which the bank can employ.

In 1900 there were 35 establishments engaged in the manufacture of safes and vaults, capitalized at \$5,479,879. There were 222 officials and salaried clerks, with yearly salaries of \$283,111; wage-earners, 2,038; wages, \$1,017,237; miscellaneous expenses, \$200,620; cost of materials used, \$1,689,148; and producing goods annually to the value of \$3,927,867. The value of the American safe has been recognized in foreign countries, and to-day may be found throughout Great Britain, Europe, Asia, Africa, Australia, South America, etc. See LOCK; FIREPROOFING; BUILDING; BUILDING: *Fireproofing*; VAULT, ETC.

Safed, *sâ'fêd*, Palestine, occupies the summit of a hill 2,700 feet high, on the shores of the Mediterranean, six miles northwest of the Sea of Galilee. Safed was a fortified place of importance during the Crusades, and is one of the four holy cities of the modern Jews in Palestine, their settlement dating from the 16th century. Pop. (estimated) 19,000.

Safety-Lamp. See LAMPS.

Safety-valve, a device used upon steam boilers and other vessels subject to an internal pressure, for the purpose of automatically preventing that pressure from rising to a dangerous intensity. It consists essentially of an opening in the boiler (or other vessel), over which a suitable lid or "valve-disk" is fitted. The valve-disk is pressed against its opening with a definite, constant pressure, whose magnitude is regulated according to the pressure that the boiler is intended to carry. So long as the pressure that the steam within the boiler exerts upon the under side of the valve disk is less

SAFFLOWER — SAFFRON

than the constant force with which the disk is pressed down upon the opening, the valve remains closed, and no steam escapes. If the pressure within the boiler rises, however, so that the steam exerts upon the disk a total pressure that is greater than the external force that tends to hold the disk in place, the valve opens and permits steam to escape until the pressure in the boiler is sufficiently reduced for the external force to again close the opening. There are three general types of safety-valve in use, which are respectively known as "dead-weight," "lever," and "pop" valves. The fundamental principle of operation is the same in all, and the classification relates merely to the means that are employed to hold the valve-disk against the opening in the boiler. In the "dead-weight" valve, this is accomplished by placing weights directly upon the valve-disk. Safety-valves of this type can be recommended for low pressure boilers, and they are greatly used, in England, upon heating boilers, and also upon kitchen boilers. They are not adapted for use in connection with high pressures, however, for the load resting upon the valve-disk must then be very great, in order to prevent the valve from opening at the ordinary running pressure. It is common, therefore, to use the "lever" type for high pressure service. In this type the valve-disk is held against its seat by the action of a weight, but the weight does not rest directly upon the disk. A horizontal lever two or three feet long is provided, and this is pivoted at one end, while the weight is attached near its free end. The centre of the valve disk comes directly under the lever, a few inches from the pivoted end, and the lever is supported by means of a stout vertical rod whose lower end rests upon the centre of the valve-disk. By this means the total downward force acting upon the disk and tending to keep it in position may easily be made to be eight or ten times as great as that which would be realized if the weight rested upon the valve-disk directly; and the pressure at which the valve will open can be nicely regulated by shifting the position of the weight upon the lever arm. In the "pop" valve, the disk is forced against its seat by means of a stout spiral spring, which is held in position by a framework, or casing, which is securely attached to the boiler. The compression on the spring is regulated by means of a screw that acts upon its upper end, and which can be turned by a wrench. It is now customary, however, to have the adjusting screw entirely within the casing of the valve, so that the attendant in charge of the boiler cannot tamper with it; the casing being provided with a lock, the key to which remains in the possession of the owner of the boiler. The name "pop" refers to the sound that these spring valves make when they open and close. Lever valves and dead-weight valves open and close gradually, and before they open they give warning by a hissing sound. "Pop" valves, on the contrary, open without any such premonitory signal, and when they close they do so with corresponding quickness. "Pop" valves are used exclusively upon railroad locomotives, as the violent swaying and vibration to which these are subject would render weighted valves undesirable.

Safflower, a large thistle-like composite plant (*Carthamus tinctorius*) with orange-colored flowers, said to have been originally brought from the East, but now naturalized in many parts of Europe, and extensively cultivated. The tubular flowerets are collected, dried, and somewhat used as a feeble laxative medicine, in place of, or as an adulterant of, saffron. They are, however, chiefly important as the source of carthamin, a dyeing principle originally much employed by the Chinese, and later by occidental silk manufacturers, as it gives brilliant, although fugitive red tints; mixed with French chalk, it forms the cosmetic rouge. In Spain the flowers are used to color soups, and other dishes. The Jews in Poland are remarkably fond of the flowers, and mix them with their bread and most of their viands. Oil, in India, is expressed from safflower seeds, for culinary and lighting purposes.

Safford, säff'örd, **Truman Henry**, American mathematician: b. Royalton, Vt., 6 Jan. 1836; d. Newark, N. J., 13 June 1901. He was early known as a calculator of great skill; in 1845 prepared an almanac; by a method of his own abridged by one fourth the task of computing the rising and setting of the moon; and after his graduation from Harvard was officially connected with the observatory there in 1854-66, acting in 1866 as director. In 1865 he was appointed professor of astronomy in the University of Chicago and director of the Dearborn observatory, in 1874-6 was a member of the United States coast-survey, and in 1876-1901 professor of astronomy in Williams College. He was a fellow of the American Academy of Arts and Sciences, of the American Association for the Advancement of Science, and an associate of the Royal Astronomical Society of England. He studied the nebulae, discovering many new ones, computed cometary and planetary orbits, and for some time devoted his attention to latitude and longitude work for the United States corps of engineers, for which he prepared a star-catalogue. Among his further published writings were a catalogue of polar-stars, 'Mathematical Teaching and its Modern Methods,' and numerous contributions to astronomical journals, to the 'Proceedings' of the American Academy, and to the notices of the Royal Society.

Safford, James Merrill, American geologist: b. Zanesville, Ohio, 13 Aug. 1822. He was graduated from the Ohio State University in 1844 and in 1848-72 occupied the chair of natural science at Cumberland University, Lebanon, Tenn. He was professor of chemistry at the University of Nashville and at Vanderbilt University in 1874-94, and of natural sciences at the latter in 1875-1900, where he now occupies the chair of geology. He was State geologist of Tennessee in 1854-60 and 1871-1900. His publications include many papers on geological subjects, beside: 'Geological Reconnaissance of Tennessee' (1856); 'Geology of Tennessee' (1869); 'Elements of the Geology of Tennessee' (1900); etc.

Saffron, a bulbous autumnal plant (*Crocus sativus*) and a commercial dye-stuff obtained from it. The cultivated saffron originated probably in the Levant, and was grown in early times about the town of Corycus, Cilicia (from which the *Crocus* genus may have taken its name).

SAG HARBOR—SAGASTA

The Arabs cultivated it in Spain, about the 10th century, and it was an important crop in England, especially about Saffron Walden, in the 15th century, bringing the highest market price. It is now raised about the Mediterranean, and in Asia. The saffron is low, with the grass-like leaves, and long-tubed, funnel-shaped flowers, springing directly from the ground, which are characteristic of the crocuses. Its flower is purple, with a style tipped with three orange-colored stigmas, each more than an inch long, depending from one side of the perianth. These stigmas are picked off in the early morning, and dried on a kiln, either loosely or between layers of paper, and under the pressure of a thick board which forms the mass into cakes, about 4,000 of these stigmas being necessary to give an ounce of saffron. In either case the commercial saffron is liable to suffer from adulteration. This adulteration was so prevalent at one time that those guilty of it (when caught) were killed.

Saffron stigmas, when genuine, have a characteristic orange red color, and an aromatic, bitter odor and taste. The substance has faint carminative and narcotic properties, but is seldom used medicinally, except for coloring tinctures. In the 'Song of Solomon' the saffron is mentioned among the sweet-smelling herbs, and it was much in demand among the Greeks and Latins for its perfume. A fragrant essence was made from it with water and wine for sprinkling in theatres and other places, even in the streets, for anointing the hair, and for the bath. Saffron was also much employed in culinary operations, chiefly for its aromatic taste and for coloring, as the clown in the 'Winter's Tale' says he "must have saffron, to color the warden pies."

Saffron, however, is most commonly used as a dye, giving a yellow hue to cloth, but is being displaced by cheaper colors. This tint was in very early times the royal color in Greece, and was that of some of the women's court robes, but afterward was appropriated by the hetairæ. In Ireland and the Hebrides it was also the color of the king's mantle, and of the shirts of persons of rank. Saffron enters largely into the composition of the sacred spot on the forehead of a Hindu Pundit. An extract made from saffron, used as a glaze on tinfoil, imitated gold in mediæval illuminations, and was also employed by painters.

HELEN INGERSOLL.

Sag Harbor, N. Y., village in Suffolk County; on Gardiner's Bay, an inlet from the Atlantic Ocean, and on the Long Island railroad; about 100 miles east of New York. It has a good harbor, regular steamer connections with New York and several of the Long Island coast towns. It has several manufactories, chief of which are a watch-case and silverware factory, flour and cotton mills, a tannery, and machine shops. The Sacred Heart Academy (R.C.), opened in 1877, a Union school, public and parish schools, and a library constitute the educational institutions. There are three banks with a combined capital of \$100,000. The village is a favorite summer resort.

At one time Sag Harbor was noted for its interests in whaling; its income from that industry amounting to \$1,000,000 some years. In those days its tonnage equaled that of New York. The Indian relics found in and near the

village show it was once an important Indian settlement. Pop. (1910) 3,408.

Saga, sǫ́gá, from the word meaning "to say," is a narrative of the past handed down by word of mouth. The name is applied to a large collection of mythical, semi-mythical, and historical works written mainly in Iceland chiefly in the 12th and three following centuries. The most conspicuous and important of the historical sagas are Snorre Sturlason's *Heimskringla*, the *Njáls Saga*, the *Egla*, and the *Sturlunga Saga*. Consult Horn's 'History of the Literature of the Scandinavian North,' translated by Anderson. In Scandinavian mythology the name of the goddess who presides over history. She dwells in *Sokkvabeg*, where she and Odin sit drinking joy from golden goblets.

Saga, sǫ́gá, Japan, capital of the province of Fizen, on the island of Kiu-siu, 74 miles northeast of Nagasaki. It is an important seaport and commercial centre. The town is intersected by numerous streams, chief of which is the channel of Sentonofutsi, 50 miles long. It unites the Gulf of Simabara with the Northern Sea, and is of considerable commercial importance. Pop. 32,753.

Sagard, sǫ́gār, Theodat Gabriel, French Roman Catholic missionary. He labored in converting the Huron Indians to Christianity during the 17th century, and contributed, in an important degree, to a knowledge of Canada in its early colonial days as "New France." His principal works are: 'Travels to the Huron Country, towards the Freshwater Sea and the Uttermost Limits of New France, called Canada; Wherein is Treated of all Matters touching the Country, the Manners and Character of the Savages; their Government and their Ways, as Well in their Own Country as when Roaming; of their Faith and Belief; with a Dictionary of the Huron Language' (1632); also, 'History of Canada and the Journey made by the Friars Minor Recollects Thither, for the Conversion of Unbelievers.' An edition of his works was published at Paris in 1866.

Sagasta, sǫ́gás-tǎ, Praxedes Mateo, Spanish statesman: b. Torrecilla en Cameros 21 July 1827; d. 5 Jan. 1903. He studied at the College of Engineers in Madrid, practised as an engineer in Valladolid and Zamora, in 1854 was elected from Zamora province to the Cortes, where his attitude was a radical one, and in 1856 for participation in an unsuccessful revolt was compelled to escape to France. Upon the proclamation of amnesty, he returned, became professor in the Madrid College of Engineering, re-entered the Cortes, was identified with the Progressive minority, and edited its journal, 'La Iberia.' After the outbreak of 22 June 1866 he again fled to France, but at the beginning of the revolution of 1868 was once more in Spain, where he became minister of the interior in the provisional government. In October 1871 he was chosen to the presidency of the Cortes, in December entered the Malcampo cabinet as minister of the interior, in February 1872 was commissioned to form a new ministry, but in May was forced to resign. In 1874 he appeared anew in office as minister for foreign affairs in the Serrano cabinet, shortly afterward ex-

changed his portfolio for that of the interior, and in August became president of the ministry. He retired from office at the accession of Alfonso XII., for a time was a leader without a party, as a member of the Cortes was finally associated with Martinez Campos (1881) in the organization of the new Liberal party, and upon the overthrow of the Conservatives became president of the ministry. He was forced from power in 1883. Subsequently he was president of the Cortes in 1883-4, and of the ministry in 1885-90 and 1892-5. In September 1897 he was again summoned to form a cabinet. He recalled Weyler from Cuba, appointed Blanco captain-general, and drafted a plan for Cuban autonomy. Although opposed to the war with the United States, he waged it with such efficiency as his limited resources would permit, and was loudly denounced for signing the treaty of peace. On 4 March 1899 he resigned with his entire cabinet, though on 6 March 1901 he again took the helm, and, after averting a Carlist insurrection, remained in office until 3 Dec. 1902. He has been characterized as "singularly devoid of the blind arrogance which has been the bane of so many Spanish statesmen." After Canovas' death, he was conceded to be the greatest political figure of Spain.

Sage, sāj, Henry William, American philanthropist: b. Middletown, Conn., 13 Jan. 1814; d. Ithaca, N. Y., 17 Sept. 1897. In 1832 he engaged in the lumber business which he conducted until 1854, and settling at Ithaca, N. Y., entered the New York Assembly in 1847. His earlier benefactions were the endowment of various schools and churches, the West Bay City, Mich., public library, and the Lyman Beecher lectureship at Yale College. In 1870 he became a trustee of Cornell University and his various gifts to that institution were \$266,000 for the Sage College for Women; \$200,000 for the Sage School of Philosophy; \$50,000 for the Susan Lynn Sage chair of philosophy; \$260,000 with an additional endowment fund of \$300,000 for the University Library Building; \$20,000 for the Museum of Classical Archaeology; \$11,000 for the Sage professorship of philosophy; \$300,000 for floating indebtedness. His careful management of timber lands owned by the institution realized for it about \$6,000,000.

Sage, Russell, American capitalist: b. Verona Township, Oneida County, N. Y., 4 Aug. 1816; d. Lawrence Beach, L. I., 22 July 1906. He began life as clerk in his brother's grocery store; entered the retail grocery business for himself in 1837, and, during 1839-57 was a wholesale grocer at Troy, N. Y. He was alderman of Troy in 1847; treasurer of Rensselaer County, and a Whig member of Congress during 1853-7. In 1863 he removed to New York and shortly began large operations in railroad and other securities. He accumulated one of the largest fortunes in America and was a director in many large corporations.

Sage, William, American novelist, son of Abby Sage Richardson (q.v.): b. Manchester 8 May 1864. He was educated in France and Germany, was engaged in railway and banking business 1881-96, and since then has given his attention to literature. He has published 'Robert Tournay' (1900); 'The Claybornes' (1902); 'Frenchy—The Story of a Gentleman.'

Sage, a name covering garden herb (*Salvia officinalis*) of diverse families, somewhat color or odor. The cultivated and the genus differs from *biata*, in having two stamens. It is a native of southern Europe, perennial of hoary aspect, wrinkled, gray-green, opposite, decumbent stems, and pale-lilac in verticillate spikes at the branches. It has been widely cultivated for at least three centuries, on account of its aromatic odor, and bitter, purgative, formerly used in medicine, stimulant, and astringent. The fusion of the plant, or *Salvia*, in England before the advent of *Salvia* was a favorite remedy for now employed as a gargle. The verb states that "He that must eat sage in May." See *Salvia*.

Many *salvias*, or sages, are cultivated for their brilliant flower colors. The scarlet *Salvia splendens* (with racemes of long, of slender flowers) is ranged in whorls, both calyx of a most brilliant scarlet and large-flowered but blue-tinted woolly white foliage of *S. splendens* it to be included in garden score of others quite worthy of ornament.

Several genera of the *Chamaedryf* which takes kindly to which inhabit the desert of North America, are called sages. Bitter sages are *C. monardella* more commonly known as *Monarda*. The salt sages are species of thousands of acres of waste strongly impregnated with that little other vegetation water is so scarce in certain deserts, stock can not be kept in summer, and the sages make the fruits, valuable for their become ripened and the leaves which, together with the stems make excellent forage, part of the flock. The flocks are taken in in snow furnishes water for salt-bushes greedily, Nuttall's *lii* being the most valuable with a deep, woody root, and seeds and all, quite down to the ground and starts up again, during it is undisturbed. In fact, the sages, by improving these pastures, and thus becoming nearly as valuable as the sweet-sage of *Salvia lanata* is another highly valued age plant, a foot or more high, base, whitened with long hairs with abundant fruit, that toward the great fattening quality this sage, which is also so beneficial effect on the grasshopper-scale, a spiny, shrubby *confertifolia* produces in shoots and thick succulent leaves quantities of flat, winged seeds.

SAGE-BRUSH — SAGINAW BAY

erly sought at the time, and, in the autumn, when leaves and fruit have dropped, and been blown into hollows of the plain, the sheep seek them out, and devour them utterly.

HELEN INGERSOLL.

Sage-brush, any one of the species of the genus *Artemisia*—composites very abundant in the arid, alkaline regions of the Western United States, where the soil is not too saline, and, with other desert vegetation, covering immense areas. The best known sage-brush is the common shrub, or bitter-sage (*A. tridentata*), which is found growing on the plains, and ascending to the sub-alpine parks of the mountains. It varies in different situations from a dwarfed shrub to almost tree-like proportions, when its trunk near the ground will measure nearly a foot through, being twisted and knotty, and loosely enveloped in a light-gray, shreddy bark.

Sage-brush State, or **Sage-hen State**, a nickname for the State of Nevada, from the large amount of sage-brush growing there.

Saginaw, Mich., a city, and county-seat of Saginaw County, on the Saginaw River, 16 miles from Saginaw Bay, 97 miles northwest of Detroit, and 65 miles northeast of the capital at Lansing. The railroads entering the city are 6 divisions of the Pere Marquette, 3 divisions of the Michigan Central and 1 division of the Grand Trunk.

History.—The City of Saginaw is a consolidation of old Saginaw City, East Saginaw and the Village of Salina or South Saginaw. The latter was incorporated as a village in 1866 and became a part of East Saginaw in March 1873. East Saginaw was incorporated as a village in 1855 and as a city in 1859. Saginaw City was never incorporated as a village, its first incorporation being as a city in 1857. The two municipalities, East Saginaw and Saginaw City, were consolidated by act of the legislature of 1889 into the City of Saginaw, and the first meeting of the common council of the consolidated city was held March 12, 1890. The site upon which this prosperous community is located was first settled in 1815 by men of French origin and half breeds. The city comprises about seven square miles, the east side being 27 feet above the river and the west side 35 feet.

Government.—The form of government is by a mayor elected every two years and a council of 20 members, one from each of 20 wards, to serve for two years. Various city boards are appointed by the mayor subject to confirmation by the council.

Manufactures, Industries, Buildings, etc.—Saginaw was at one time the centre of the white pine industry, and millions of dollars worth of logs have been floated on the bosom of her river. This vast industry has of late years given way, in a measure, to manufacturing, and the city is now (1904) distinctively a manufacturing and jobbing centre. Some of the manufactures are beet sugar, plate glass, salt, iron and steel products, furniture, pianos and musical instruments, vehicles, baskets and a great variety of wood products, malt liquor and flour. It has planing mills, lumber assorting yards, brick yards, tanneries, graphite works and a variety of foundry and machine shops, in addition to the big shops of the Pere Marquette R.R. Co. The bituminous coal fields of Saginaw and vicinity employ 1,500 miners from the

city alone, and the pay roll is \$100,000 a month. The total number of wage earners in Saginaw is 26,000. According to the 1900 census, the number of manufacturing institutions in the city was 480, with a capital of \$7,558,806; number of employes, 4,866; annual wages paid, \$1,936,558; value of output, \$10,034,499. The assessed valuation of Saginaw for 1904 was \$23,971,068, and the net debt of the city was \$1,524,022, but this includes water bonds of \$500,000 on a water plant valued at \$1,000,000, which the city owns. The total expense for running the city for the year was \$420,861. The city has 58 miles of water mains and uses the Holly system of water supply, from two pumping stations, one on each side of the river. It has a fine sewerage system with 70 miles of sewers; 10 small parks; 54 miles of finely paved and beautifully kept streets, many of them laid with asphalt. The streets of the city are for the most part notable for their width. They are traversed by an excellent electric street railway system, and two interurban roads reach out into the surrounding country. The city has 46 church edifices and 5 missions. The hospitals are the Saginaw General Hospital, Saint Mary's Hospital, and the Woman's Hospital. Other charitable institutions are the Home for the Friendless, and Saint Vincent's Orphan Home. Fiduciary institutions are represented by 6 national and State banks, with a capitalization of \$700,000 and \$600,000 surplus and deposits of over \$10,000,000. Besides these, there are 2 private banks. Saginaw possesses a \$200,000 Manual Training School, and is also the seat of the Michigan Employment Institution for the Blind. It has the Hoyt Reference Library of 27,000 volumes, besides 2 other public circulating libraries. The educational system has at its head 2 finely equipped High Schools and the graded schools require 26 buildings, nearly all of the most modern character. There are in addition several private business colleges, the German Lutheran Theological Seminary, and 16 parish and parochial schools and academies. The city has one of the finest Masonic Temples in the State, a handsome Federal Building, 2 theatres and numerous capacious public halls. The east and west sides are connected by a number of fine bridges over the river, so that access is easily obtained from the business centre to the most remote parts of the city. In addition to the numerous small parks, the city has a large suburban resort, operated in connection with the street railway system. The population of Saginaw is cosmopolitan in character, the German possibly predominating, as attested by their numerous large and prosperous societies of an educational and social character. The Irish, French, and Bohemian are also conspicuous elements of the city's population, which, according to the census of 1910 is 50,510.

JOHN T. WINSHIP,
Editor 'Saginaw Evening News.'

Saginaw, a river in Michigan which is formed by the junction of the Flint and Shiawassee, and flows nearly due north into Saginaw Bay. The main stream is only about 30 miles long, but with its branches it drains a large portion of the Lower Peninsula. It is navigable to the city of Saginaw, 24 miles.

Saginaw Bay, the largest inlet of Lake Huron on the coast of the United States. It

SAGITTARIA — SAGUNTUM

indents the east coast of the Lower Peninsula of Michigan. It is about 60 miles long and 30 miles wide. It is a safe harbor and never dangerously rough, although it is sometimes subject to storms. The color of the water is different from that of the open lake; it is a brownish-green.

Sagittaria, sāj-i-tā'ri-ā, a genus of the water-plantain family (*Alismæ*). It is a widely distributed genus, wholly or partly aquatic, native to the temperate zones and the tropics. The species are handsome, with lance-like, elliptical or arrow-shaped leaves, erect or floating; the flowers are verticillate in trios around the upper part of the scapes, that carry them well above the water, and are 3-merous, with beautiful white and crinkled fugacious petals. The common arrow-head (*S. variabilis*), grows in the mud along rivers and ditches, and is very ornamental with its charming whorls of flowers rising from the centre of a cluster of large, erect sagittate leaves, varying surprisingly in different plants in respect to size and shape. It is a perennial, with thick fibrous rootstocks, which produce oval, fleshy tubers, often as large as a hen's egg, abounding in starch, and a staple and nutritious article of food with many Indian tribes. The squaws sometimes waded into the mud where the arrowheads grew thickly, loosened the tubers with their toes, and when the plants floated to the surface, captured them and flung them into canoes, to be boiled or roasted. *S. climensis* is cultivated in China for food.

Sagittarius, sāj-i-tā'ri-ūs, in astronomy, the ninth sign of the zodiac, into which the sun enters 22 November. The constellation consists of eight visible stars. It is represented on celestial globes and charts by the figure of a centaur in the act of shooting an arrow from his bow.

Sago, a farinaceous food, obtained from the central portion of various species of tropical palms, principally, however, from *Metroxylon rumphii*, or *M. lavius*. The sago-palms flourish in wet soil, and are cultivated in the East Indies, and particularly in Sarawak. They are rarely over 30 feet high and have stout stems, with an outer rind about two inches thick, as hard as bamboo, but filled with spongy pith, containing a large proportion of starch.

The preparation of sago is one of the industries of the East Indies. The trees flower only once, and if allowed to do so, and to fruit, would exhaust the mass of starch stored in their stems, and then die, after propagating themselves either by seeds or by offshoots. To prevent this, the trees are felled when they are about 15 years old, and on the point of flowering. The starchy tissue, then most productive, is extracted, and pounded or grated to a powder. This is kneaded in water, in a cloth or sieve, the escaping water carrying the starch into a trough, where it is washed and settled out, until fit for use. The water is then drawn off, and the caked residue is ready for native cookery. This cake, or meal, when made into a paste and pressed through a sieve, forms fine pearly grains, which are left either in their original brownish hue, or are bleached, and compose the commercial product "pearl-sago."

Sago-meal is eaten by the natives as pottage, or as biscuits, partially baked in earthen molds. It is not entirely soluble in hot water, as is ordinary starch, and can therefore be employed in making puddings, etc., forming a valuable article of food, as it is cheap, nutritious and easy of digestion. In Europe it is used for feeding stock, making starch, and by cocoa manufacturers for their beverages. Inferior qualities of sago are produced by *Phoenix farinifera*, *Corypha* of various species, *Caryota urens*, *Raphia flabelliformis*, and two South American palms.

Portland sago is a delicate farina extracted from the corm of the European wake-robin (*Arum maculatum*). Wild sago is the product of the coontie-root (*Zamia integrifolia*), a cycadaceous plant of Florida, well known as an article of food among the Seminoles; and other cycads, incorrectly called "sago-palms," furnish a coarse kind of sago.

Sagoin, sa-goin', or **Sagouin**, a French form of the native South American name of a genus (*Callithrix*) of Brazilian monkeys, of small size and remarkably light, active, and graceful in their movements.

Sa''goyewath'a. See RED JACKET.

Sagua la Grande, sā'gwā lā grān'dā, Cuba, town, province of Santa Clara; on the Sagua la Grande River; 150 miles east of Havana. It is connected by railroad with La Isabela, its port on the north coast, with Cienfuegos, Havana, and Matanzas, and with towns to the east; and carries on a considerable trade, sugar and molasses being the chief exports. Formerly gold was mined in the vicinity to some extent. It is well built, with wide and regular streets; among its public buildings are a hospital, a town hall, and a large church; it has also several schools.

Saguenay, sāg-ě-nā, Canada, a large river in the province of Quebec, emptying into the Saint Lawrence at Tadousac Harbor. It is about 100 miles long with a remarkable depth — 17 to 500 fathoms. It drains Lake Saint John and flows with almost unparalleled impetuosity, between high rocky walls and over deep precipices, forming numerous falls and cataracts in its upper course. Its magnificent scenery attracts many tourists. It is navigable for large vessels as far as Ha Ha Bay, 10 miles south of Chicoutimi.

Saguntum, sa-gūn'tūm, or **Murviedro**, Spain (*Hispania Tarraconensis*), situated near the mouth of the Palantias, three miles from the coast and 18 miles by rail from Valencia; was a rich commercial town in early times, especially famous for its figs and manufacture of a certain kind of pottery. The town was founded by Greek and Italian colonists. In the interval between the first and second Punic wars, it formed an alliance with the Romans, and became celebrated for the resistance it made to Hannibal in the siege of 219-18 B.C. The city was nearly destroyed at this time, but the Romans rebuilt it and made it a colony. The ancient city is now replaced by the modern Murviedro, and the only important ruins are those of the theatre. Pop. (1900) 6,784.

Sahara, ṣa-hā'ra, Africa, the great desert region in the north of the continent, extending from the Atlantic eastward as far as the Nile, and from the Mediterranean provinces to the Niger and Lake Tchad. Its area contains 3,459,500 square miles,—a region equal to the whole of Europe. The configuration is irregular and the surface highly diversified, reaching from 100 feet below the sea-level to an altitude of from 5,000 to 8,000 feet in Mount Tusidde. Some of the highest summits are those of the Ahaggar, a great mountain plateau. Air or Asben is an isolated mountain, midway between Tibesti and the Niger. Farther south is the extensive plateau of Adghagh. At the northeast in Fezzan are the dark mountains of Jebel es Sôda. The rest of the Sahara consists generally of undulating rocky surfaces and sand dunes interspersed with occasional oases. The date-palm flourishes on these green spots, also the olive tree. Apples, peaches, oranges, grapes, etc., grow and wheat, barley, rice, durra and other tropical crops are raised, and there is a considerable variety of flora. Mammals consist, outside of the domestic animals, such as camels, asses, black cattle, etc., of 15 species, comprising the jerboa, fox, jackal, baboons, hyenas, mountain sheep, etc.; about 80 species of birds, among which is the ostrich. There are also tortoises, lizards, chameleons, serpents, such as the python, horned viper, etc. The edible frog and fish also occur. There is an important trade in silk tissues and mixed goods, ivory, ostrich feathers, gums, spices, musk, hides, gold dust, indigo, cotton, palm oil, kola nuts, silver, dates, salt, and alum. The exports are textiles, weapons, gunpowder, etc. Many thousand tons of phosphate are extracted. The range of temperature is very great. The chief centres of population are the oases. The inhabitants consist of Moors, Tuareg, Tibbu, Negroes, Arabs, and Jews; the former occupy the region between Fezzan and Lake Tchad. The tribes south of Algeria and Tunis. The Tuareg control the principal caravan routes. The Tibbu, who number about 200,000, live in the oases between Fezzan and Lake Tchad. The tribes of the desert are, generally speaking, camel drivers, slave and salt dealers, guides, and robbers. A few possess date-groves, but they usually subsist on the milk of their herds, bartering for fruits or grain. The principal caravan routes lead from Timbuktu to the Wady Draha, and to the oasis of Twat; from Haussa by Air or Asben and Ghat to Ghadames and Murzuk; from Bornu by Bilma and Murzuk to Tripoli; from Waday by Ojariga, Kufara, and Aujilah to Benghazi, and from Darfur to Siut. Pop. about 2,000,000.

Sahâranpur, ṣa-hâr-an-poor', or **Seharun-poor**, sê-hâr-ün-poor', India, (1) capital of a district of the same name, in the United Provinces, 90 miles northeast of Delhi. It is an important railway junction. Among the buildings the most noteworthy are an old Rohilla fort (used as a court-house), and a fine Mohammedan mosque. The residential part is substantial and modern. There is a church, an American Presbyterian mission and a fine botanical garden for experiments in tea and cinchona. Commerce in grain, sugar, molasses

and country cloth is considerable. Pop. about 70,000.

(2) The district in the Meerut division has an area of 2,242 square miles, and occupies an alluvial table-land between the Ganges and the Jumna. It consists partly of wild, picturesque broken ground, but the larger portion is tillable. Cereals form the chief products, and its commercial importance is considerable. Pop. about 1,200,000.

Sahib, sā'ib, the term of native address in India toward a respectable European. It is an Arabic word, signifying companion or lord. The feminine form is *Sahibâ*.

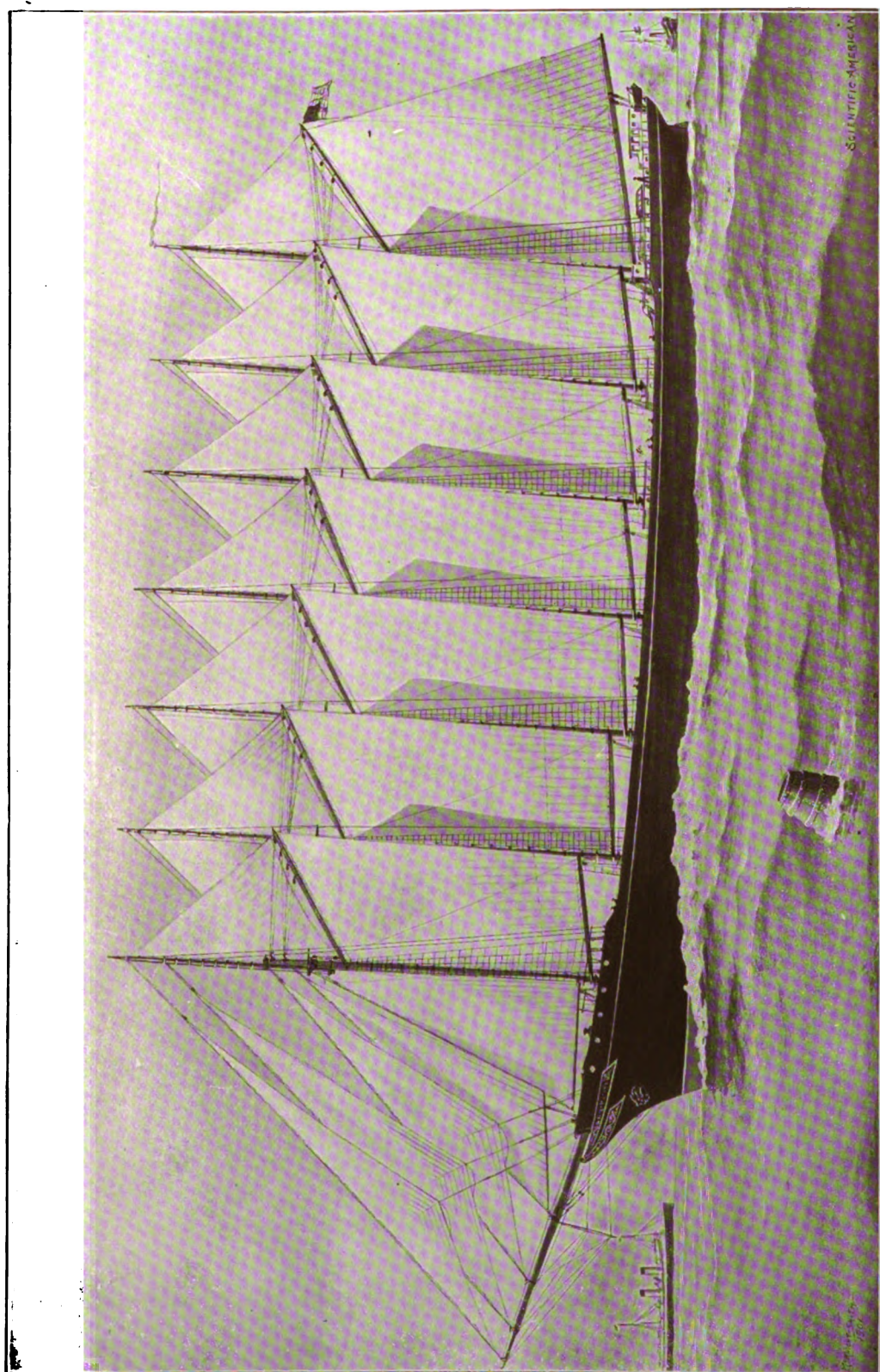
Sai, sā'ī, a Brazilian native name of indefinite application for a local monkey, most often, perhaps, designating the capuchin (*Cebus capucinus*).

Said Pasha, sā-ēd pāsh'ā, Turkish statesman. He was premier 1879-82, was appointed grand vizier 3 Dec. 1882, was twice dismissed and reinstated by the sultan in 1883, his foreign policy and his reformatory measures concerning internal affairs first arousing displeasure against him, and a suspected complicity in a plot for the sultan's assassination caused the second dismissal, which was revoked two days later. In 1885-95 he was minister of foreign affairs.

Saiga, sī'ga, an antelope (*Saiga tartarica*) found on the steppes of Russia and in western Asia. It is about 2½ feet high at the shoulders, pale bluish gray in color, and is remarkable for the greatly swollen appearance of the nose, due to the thick cartilaginous coverings of the nostrils. It once had a far wider habitat in Europe, and is steadily diminishing in range and numbers.

Saigon, sī-gōn (Fr. si-gôn), or **Sai-gun**, Indo-China, the capital of Lower Cochinchina before the French conquest, is on the right bank of the Saigon or Dou-nai River, 34 miles from the sea. The town was nearly destroyed by the French, and the present city dates practically from 1861. It has fine public buildings, modern shaded streets, and zoological and botanical gardens; of educational institutions, the colleges of Chasseloup-Laubat and d'Adran are the most important. There is a large floating dock. The majority of the population is Asiatic, the Chinese element predominating. The town has an active trade with China, Siam, Singapore, and Java. Considerable French and English goods are imported. The main exports are rice, cotton, silk and hides. The great market is Cholon, 3½ miles from Saigon. Pop. about 80,000; Cholon, 127,000.

Sail, or **Sail-tailed Lizard**, a large agamoid lizard (*Lophurus amboinensis*) of the Philippines, Celebes, Java, and neighboring islands, which takes its name from the tall sail-like crest bone upon the upper surface of the tail of the adult, which is supported by a great lengthening of the spines of the vertebrae of that region; the tail otherwise is highly compressed, long and powerful. This lizard frequently exceeds three in feet in length, is olive-green spotted and marbled with black, and has many curious folds of skin about the neck. It is strong and active and spends much of its time in trees, but when alarmed or chased



THE FIRST SEVEN-MASTED STEEL SCHOONER.

Length, 305 feet; Beam, 50 feet; Molded Depth, 34 feet 5 inches; Displacement, 10,000 tons; Cargo Capacity, 7,500 tons; Total Sail Area, 40,617 square feet.

SAIL—SAILING VESSELS

rushes for water, dives to the bottom and endeavors to hide among the stones. It is defenseless and harmless, and its flesh, which is white and tender, is much liked by the islanders.

Sail. See SHIP.

Sailcloth, a coarse, strong linen, cotton or hempen cloth used in making sails. The best is made of flax, and combines flexibility with lightness and strength. See SHIP.

Sailfish, a large predaceous fish (*Istiophorus nigricans*) of the West Indian and neighboring waters, which is closely allied to the sword-fishes and of the same family as the spear-fishes (*Tetrapturus*). It reaches a length of six feet, has an elongated, much compressed body, covered with elongate scutes, and a powerful, deeply forked tail; while the dorsal fin is, relatively, of huge size and deeply notched outline, well simulating the appearance of a ship under sail as it appears above the water when the fish glides along the surface as it frequently does. The bones of the nose are prolonged into a "sword," not so long as that of the swordfish, but sharper, and an effective weapon in a school of small fish.

Sailing. See NAVIGATION; SHIPS; SAIL AND STEAM.

Sailing Vessels. The first vessel of which history gives any description is the Ark, as built by Noah. Its proportions possess some interest, because, though not intended for a voyage, it may be inferred that it was constructed to float with as little motion as possible, considering that it "went upon the face of the waters" for about five months. Assuming a cubit to be about 21 inches, its length was 525 feet, its breadth 87 feet 6 inches, and its depth 52 feet 6 inches. Its length is thus seen to have been six times its breadth, which proportion is about an average of all types of vessels. Its draft of water must have varied greatly during the period of its occupation, as 12 months' provisions must have formed a very large proportion of the original weight, and these must have been gradually consumed. It had three decks; but was fitted with neither masts, sails, nor rudder.

Ancient History.—The paintings and sculptures, as the early records of Egypt, show regularly formed boats constructed of sawn planks of timber, propelled by numerous rowers, and also by sails. These vessels were long galleys with one mast and a large square sail, which was sometimes of linen and sometimes of papyrus. The Hebrews in the time of Solomon must have possessed vessels of considerable size, as mention is made in the sacred writings of that date of stately ships, and of voyages made to bring trees of considerable size to be used in the building of the temple. The Phœnicians were connected with the Hebrews in their maritime expeditions, and this people appear to have been the most enterprising in navigation of all the nations of antiquity. Herodotus tells us of their feat of circumnavigating the continent of Africa in 604 B.C. They started from the Red Sea, passing Ophir on east coast of Africa, then rounded the Cape, and keeping by the west shore they entered the Mediterranean Sea through the Straits of Gibraltar, and arrived in Egypt in the third

year of their expedition. Little doubt exists of the Phœnicians having been the discoverers of the art of sailing, as their skill in evading Nebuchadnezzar at the siege of Tyre for 13 years, shows that they possessed more than a superficial knowledge of navigation. They were also engaged in concert with other nations in wars with the Greeks: and it was from them the latter nation learned in their conflicts what they knew of ships and navigation. The fact of the Grecian mariners making use of the screw pump to discharge water from their vessels' holds, would lead to the conclusion that their vessels were no mere sloops. An evidence of the want of strength in the construction of these ancient vessels, is the fact of their being bound around the outside with heavy ropes. They were sometimes carried as part of the vessel's outfit, and used as necessity required. Out at sea and in heavy weather, there they were made use of. There were sometimes as many as 8 or 10 bands running fore and aft of the vessel.

Roman Galleys.—The Romans in the early stage of their history paid little attention to navigation, until it was forced upon them by the necessity of competing with their rivals, the Carthaginians. The galleys of this period ranged from a single bank up to five banks of oars. The oars in these large galleys were arranged in sets or banks, the number of these could be increased to any extent by giving increased length to the galley. The trireme, or three-bank galley, appears to have been generally open, in the waist where the rowers sat, with decks or platforms at both ends for the soldiers. The galleys of greater size than the three tiers, appear to have been always decked vessels. At the time of the first Punic war the Roman fleet is said to have consisted of 330 vessels, each containing 300 rowers and 120 soldiers. The triremes were each 105 feet long and 11 feet wide, and the quadriremes were 125 feet by 13 feet.

Merchant Ships.—It is generally supposed that ships intended only for merchant purposes were first built by the Genoese, and that not until the beginning of the 14th century were sails first used by that people. The fishing boats were the small beginning from which sprang the sailers and the larger sail vessels of a later period. In England, as early as 1344, many vessels of this character were in service. In the middle of the 15th century many large vessels were built in England. Prior to this the compass had come into more general use, and it was now possible to engage in longer voyages. The discovery of America and the passage around the Cape of Good Hope were early fruits of these improvements. The Portuguese employed vessels of small size in their voyages of discovery, but the Spaniards built larger vessels and long maintained a superiority in this respect. England was far behind the Peninsular nations in commercial enterprise at the opening of the 16th century; and at the close of the century the merchant marine was in a very depressed condition. Internal discords had put a damper on the enterprise of the merchants, and as the island was not yet famed for its manufactures, commerce drooped with every disaster to trade. The Dutch had monop-

SAILING VESSELS

olized the East Indies trade and Holland bid fair to enrich herself at the expense of her neighbor. The British East Indies Company was formed, vessels built for the trade, and the merchants again prospered. (See *SHIP*.)

The First American Ships.—This continent having been fitted by nature in supplying it with an abundance of good timber, vessels have been built upon our shores from the first year of actual settlement. The first ship constructed was for the purpose of carrying a small band of settlers back to England, who were discouraged with their prospects after the first winter. The vessel was built at the mouth of the Kennebec River in Maine. It was a staunch and excellent little vessel, a two-master, named *Virginia*. She is believed to have been about 60 feet long and 17 feet beam and 10½ feet deep. The next vessel built was at New York in 1614 or 1615 by Captain Adrien Blok, who had lost his ship *Tiger* by fire while lying at Manhattan River. His new vessel was named *Onrust*, or *Restless*, and was 38 feet keel, 44½ feet long over all, and 11 feet beam. This vessel was employed for several years in exploring the Atlantic coast from the 38th to the 42d degree of latitude. Block Island was visited during one of the excursions, and took its name from Adrien Blok. With the exception of fishing boats and shallops, there is no record of the construction of any other boats until 1631. In that year the bark *Blessing of the Bay* was launched at Medford, Mass., for the use of the Massachusetts colony. In the course of the season this vessel made several coasting trips, and soon after visited Manhattan Island and Long Island. It is thought the vessel was lost with a load of furs and fish in 1633 off the capes of Virginia.

Early Shipbuilding.—Shipbuilding at this time appears to have received its first impulse from the same cause which threw the colonists upon their own resources for the supply of many of the necessities of life. They had been hitherto supplied with all but their corn and fish, by the many emigrant ships which had yearly added to their numbers. A suspension of this emigration was brought about by the civil wars in England, and the diminished intercourse caused thereby left them dependent on mercantile enterprise alone, which the state of navigation then rendered precarious in the extreme. Governor Winthrop then said, "The general fear, of the want of foreign commodities, now our money was gone, and things were like to go well in England, set us on work to provide shipping of our own: for which end Mr. Peter, being a man of very public spirit and singular activity for all occasions, procured some to join for building a ship at Salem of 300 tons, and the inhabitants of Boston, stirred up by his example, set upon the building of another at Boston of 150 tons. The work was hard to accomplish for want of money, etc., but our shipwrights were content to take such pay as the country could make." He speaks in another place of the *Trial* of 160 tons, as the first ship built at Boston. She sailed for Bilbao on 4 June 1642, laden with fish, "which she sold there at good rate, and from thence freighted to Malaga." Thus

early began the profitable trade to distant ports from New England. An early and successful prosecution of the business of shipbuilding could have been more reasonably expected of none of the first colonists of America, than of the settlers of Manhattan. Holland was at that period, and long after, in the enjoyment of the carrying trade of the world. Though not possessed of a foot of timber, she built and armed more ships than all the rest of Europe. Planted by this commercial people, and by merchants and capitalists of Amsterdam, then the mercantile metropolis of Europe, exclusively for the purposes of trade, it appears somewhat surprising that the facilities afforded by the new territory for shipbuilding were not made available to a greater extent by the parent nation. But the administration of a privileged mercantile association, such as the West India Company, which, in 1621, was invested with a monopoly of its trade, was unfavorable to the development of the resources of the colony. About 1630 the carrying trade between Holland and America, and the trade with Brazil, where the company had sustained losses equivalent to "one hundred tons of gold," were thrown open to the colonists, and private ships were for the first time entered at Amsterdam, and publicly advertised for New Netherlands. Other restrictions, which had fettered commerce, were soon after removed, and the trade of the world with the exception of that to the East Indies, and the trade in furs, were open to the colonists. In 1678 the shipping owned in the port consisted of three ships and fifteen sloops, and other small sailing vessels. In 1694 the shipping had increased to 60 ships and 102 sloops. This was on account of a monopoly of exporting flour and biscuits from the province. South of New York during colonial times, there was little or no construction of vessels. New England developed her large shipping interests through the fisheries, that were at her door, and the coasting trade maintained by the latter extended as far south as the West Indies during these early days. It might be said the fisheries were the cause of the large merchant marine of New England.

The Schooner.—In 1745 Andrew Robinson of Gloucester, Mass., built a vessel with a square stern, which was fitted with two masts, bearing a sloop sail on each, and a bowsprit with jib. She was sharp on the bottom, and on being launched, sped over the water so fast from the impetus gained by descending from the ways as to elicit from a bystander the remark, "See how she scoons." *Scoon* was a word used by plain people to express the skipping of a flat stone over the surface of the water when skillfully thrown; and the builder of the vessel, having been somewhat at a loss for a name for the new rig, seized upon the trifling incident and replied, "A schooner let her be," and two-masted vessels, with jibs, and fore and aft sails have since been called by that name. This vessel was probably used in the fisheries. The largest schooners were those sent to the Grand Banks, and for many years after 1800 about 70 sail vessels were sent annually to the Grand Banks, chiefly from Cape Ann. These early vessels were from 20 to 40 tons.

Colonial Merchant Marine.—Before the Revolutionary War our merchant marine was

in a prosperous condition, and took nearly first rank with us. By 1760 from 300 to 400 trading vessels were being built annually in the different provinces. During the War of the Revolution the whaling and fishing fleets were almost annihilated by raids on the coast towns, by English cruisers. Foreign trade in our vessels suffered the same fate. A large part of the merchant and fishing fleet was employed during the war in privateering, and it became a profitable field for them at times, as small armed sloops frequently captured a large merchantman with the British flag. The larger privateers built during the war, when the conflict was over, were converted into merchantmen, and sent to the East Indies to trade. The Baltimore built schooner took high rank as a privateer during the war. The 16 years that followed ending with the War of 1812 were perilous times for American shipping. England excluded us from a profitable trade with the British West Indies, and the same interests led to the searching of our merchant vessels for British subjects, the capture and confiscation of our vessels and cargoes, and a detention of a large number of them for evasions of the British law. Then came on the War of 1812 that lasted for nearly three years, during which many privateers were constructed that subsequently pursued the peaceful pursuit of trade. A change in the form of our sailing vessels now began to appear, giving them better entrance lines, and cutting off those high poop decks that had been such a fixture on large vessels for many years, being among several changes that were made.

The Carrying Trade.—Prior to the War of 1812 our coastwise trade was carried on by no larger sailing vessels than those that were schooner rigged, while our foreign trade was most largely carried on in foreign bottoms. Before 1812 a few sailing packets, or vessels carrying both passengers and freight, were brought into the transportation business, and cleared from port on regular days in each month, and were operated between special points only. When the war ended there were only a few small British ships in the packet service between England and America, and very few between America and other parts of the world. Soon after the peace, however, a large number of lines came into existence as a natural outgrowth of the rush of emigration from Europe to America, and the general expansion of ocean travel and trade. The carrying of passengers was a profitable business, and there was considerable competition among shipping merchants to get the most business for their vessels. None but the best and finest vessels could be used in this trade, and the old-fashioned freighting vessels with their small cabins and houses, and poop decks, were subjected to many changes to adapt them to the passenger business. The merchants at most all our coastwise ports, from Portland, Maine, to New Orleans, La., soon saw the advantage of these packets for our coastwise trade, and regular established lines were soon in operation that remained as carriers until the coastwise steamship lines began operations in 1847, when these lines of sailing vessels gradually withdrew from business. In this trade brigs, schooners, and barks were used, while in the foreign service ships and barks only were placed in service.

Packet Lines.—It was packet business between New York and England mainly centred. There were many ports, but New York was kept the lead, and had the finest vessels for the service. The first vessels for the service were the "Wright & Co., of New York," the "Mous Black Ball Line," so called for a black dot in a white field, as the pennant of the ship, the first four vessels in this line were 500 tons, and named "James Cropper," and "W. This line was subsequently & Co., Charles H. Marshall were placed in the Liverpool once a month at first, and in 1821 the average time in voyage was 23 days, and for return but one of the later ships, made the outward voyage in 19 hours. A London line followed, and then a Havre line in 1821 a second Liverpool line from New York by Byrne known as the Red Star line, Manhattan, Hercules, Pantheing once a month, and soon after Co., afterward Grinnell, Mint the Swallow Tail line withing from New York at this time for Liverpool each week. In fare in the cabin from Liverpool including beds, bedding, wines, and description. The London line twice a month, and the Havre sailings a month. There were sailing packets to South American ports. In 1830 there were 1,500 ships, 28 barks, 714 brigs, sloops, 1 ketch, and 1 felucca were American, 92 British, Swedish, 2 Hamburg, 5 French, Haitian, 9 Danish, 2 Brazilian, Portuguese. The number of passengers was 1,310, and passengers, 16 Griswold established a Liverpool line, that had been increased to 100 vessels. These vessels down or two-decked vessels, and size to 900 or 1,000 tons. The space, aft, was divided into three parts, the middle portion for passengers, the middle portion for kitchens, pantries, etc. The crew and crew were placed forward. There were frequent sailings of the line, but all American, from New York and Philadelphia to Great Britain and parts of Europe. All the great speed, and made the Atlantic in excellent time. The line once ran from New York to Liverpool in 11½ days. The Mary Anne ran from Baltimore to Liverpool, but the usual time was 19 days. Liverpool, and from 30 to 35 English steamers were sent to Liverpool in 1840 to compete with these the steamers did not at first average time on a voyage that in the course of a few years speed and their additional

SAILING VESSELS

gave them an advantage, and the packets could no longer successfully compete with them.

Clipper Ships.—After the packets came the clipper ships, vessels intended primarily for freighting, and built to secure the highest possible speed when laden with cargo. The packets were the fast sailers from 1816 to 1845, but after the latter date there grew up various branches of trade in which a quick delivery was as important for commercial purposes as it was for the passenger trade. For instance there was the tea trade from China to the United States, in which speed has always been considered essential. The cargoes consisted of teas, spices, coffee, dried fruits, etc., which were liable to deteriorate in a long voyage of four months to the home port, and to shorten the voyage as much as possible was desirable for many reasons. There were no telegraph lines and ocean cables in those days, and the uncertainty of the markets made fast trips home from the East Indies very important. Merchants had repeatedly suffered heavy loss, sometimes business ruin by the decline in eastern goods brought home by ships during their absence on the voyage out and back, and good ships were therefore always required in that trade. The first clippers were built at New York. The pioneer was the *Helena*, built by William H. Webb, whose dimensions were 135 feet length on deck, 30 feet 6 inches beam, and 20 feet depth of hold. She came out in 1841, and was constructed for A. and N. Griswold for the China trade. She was a good sea boat and a very fast sailer for her day, making many fast voyages between China and other East Indian countries, and New York. Following the *Helena* came the *Rainbow* of 750 tons, built by Smith and Dimon in 1843 for Howland and Aspinwall. This vessel made the voyage to Canton and return home in six months and 14 days, having spent three weeks of the time in loading and discharging cargo. The *Helena* and the *Rainbow* brought about a great change in this type of vessel. They commanded better prices for freights than slow ships, and in every way proved desirable. Then in 1844 followed the *Montauk* of 540 tons for William S. Wetmore, built by William H. Webb. Then A. A. Low & Co. had Brown & Bell construct for them the *Howqua* of 706 tons, a very fast and fine vessel, which made a voyage from Shanghai to New York in 87 days. The owners of the *Rainbow* then had the noted clipper *Sea Witch* built of 907 tons by Smith & Dimon, with the intention to have the fastest vessel of the type afloat. This vessel had finer under water lines than her predecessors, and may be said to have been the first of that advanced type of fast clipper ships. She made one voyage to California in 97 days. The era of fast clipper ships was now fairly inaugurated, and many of this class were now built not only at New York, but at Boston, Philadelphia, and Baltimore. Nearly all the early ones did not exceed 1,000 tons register, or about 165 feet long, but competition led to a great increase in size, and every year saw vessels launched that spread more and more canvas, longer, larger, and faster than ever, and expressly intended to excel everything that had preceded them in the merchant shipping of the world. In 10 years after the first clipper ship

the size of 2,400 tons was reached, and there were many built of 2,000 tons each.

British Rivalry.—Foreign merchants were by no means idle spectators of what was going on in this country, and in 1846 England began to awake to the new and dangerous rivalry from America. Alex. Hall & Co. of Aberdeen made a specialty of clipper ships, and there were launched from their yard many superior and famous vessels. But the Americans, though hard pressed, were able to maintain the lead, and entitled to the best record ever made by ships sailing under canvas. There were several famous races home from China. Once the British clippers *Chrysolite* and *Stornaway*, and the American clippers *Race Horse*, *Surprise*, and *Challenge* engaged in a race from Canton to Liverpool and Deal, and arrived at the home ports as follows: At Liverpool, *Chrysolite* in 106 days; at Deal, *Stornaway* in 109 days; *Challenge* in 105 days; *Surprise* in 106 days. The British ship *Challenge* ran from Shanghai to Deal in 113 days, and the American clipper *Nightingale* in 110 days. These races were claimed by both parties; but the Americans kept the reputation of superiority, and several ships were ordered at our ship yards for foreign account. Then shortly after the gold fever broke out in California, and the John Bertram of 1,100 tons was built at Boston, Mass., and sent to the Pacific coast in 1850 by Boston parties. This was the first clipper ship built for the California trade. The *Witch of the Wave* and four others of 1,500 tons each, were immediately after built for the same parties.

Sailing Speed.—The speed of the clippers was remarkable. Six miles an hour was a good average rate of speed for long voyages, and nine miles an hour excellent time, especially for a ship loaded with a full cargo of merchandise. Clippers ran across the Atlantic to Liverpool at an average speed of nine miles an hour, spurring at the rate of from 10 to 13 miles with a favorable wind, and on voyages that gave them the advantage of the trade winds they ran for days and weeks in succession at an average speed of from 12 to 15 miles an hour. To sail 300 miles a day was not exceptional. The largest of them all was the *Great Republic*, built by Donald McKay in 1853 at East Boston. The length on load line was 314 feet, beam molded 49¼ feet, molded depth 32 feet. One of the noted clippers of the day was the *Dreadnought* built in 1853 at Newburyport, Mass. In 1859 she made the voyage from Sandy Hook to Liverpool in 13 days and 8 hours, and in 1860 from Sandy Hook to Queens-town in 9 days and 17 hours. After 1860 there was no longer any necessity for great size and speed in this type of vessel. Too many ships had been built, and a reaction set in that lasted for many years. By 1857 there were from 80 to 100 large ships in the California trade, and the rates of freight fell off one half, and the ships were thrown into the general trade of the world. In the next place, steam vessels, about 1852, had been built to run on all the principal ocean routes, and there was no longer any need for sailing vessels to be fitted out with large cabins and roomy passenger accommodations. This ended the career of those fast clipper ships that had such a world-wide reputation from

SAILOR'S CHOICE—SAILOR'S CREEK

1850 to 1860. Then the Civil War came on, and our foreign trade was cut off for four years. After 1865 the grain trade attracted the larger sailing vessels. This type of vessel was no longer an extreme clipper of the former period, but a handsome, medium clipper, of about 2,000 tons register, capable of carrying a large cargo at a fair rate of speed. These vessels continued in the Atlantic-Pacific trade until the American Hawaiian Steamship Line commenced operations, in 1900.

Modern Schooners.—The schooner, as previously mentioned, was the product of a comparatively early date. It was largely used in the coastwise trade, to the West Indies, to South America, and later to Africa, and it may be said has not fallen from favor even to this day. The early vessels were not over on an average, 75 tons. When it became necessary to increase the tonnage of the vessel it was thought to be advantageous to increase the power, so three masts were adopted. The earliest date of the building of a three-masted schooner in this country is thought to be about 1831. There were a few more built about 1845, and in 1847 the *Midas* was converted into a three-masted schooner, the *Zachary Taylor* was built at Philadelphia in 1849, and the *Spray* at Wilmington, Del., the same year. The period when this type of sailing vessel had passed the experimental stage appears to have been in 1853 when there were built the *Gardner Pike*, the *James H. Chadbourne*, the *Kate Brigham*, and the *E. R. Bennett*; and in 1855 the *Eckford Webb*, and the *William L. Burroughs*; and in 1856 the *Hartstein* and the *Cordelia*. The two latter were two-deck vessels, and were the largest of the type built for some years. These vessels were used mainly in our coasting trade, as far south as the Gulf of Mexico ports. There were a few more built prior to 1860; the Civil War came on when but few, if any, were built. It was 1868 before three-masted schooners were again constructed, and by 1873 they were the most popular type of our coastwise sailing vessels. The first four-masted schooner was the *William L. White* built at Bath, Maine, and completed in June 1880. The Northern lakes also had four-masters immediately after the *William L. White*. Then it was some years before the pioneer five-master was constructed in 1888 at Waldoboro, Maine, as the *Governor Ames*. The latter was the largest schooner for 12 years, until the *George W. Wells* was built in 1900 as a six-masted schooner. The largest of them all is the *Thomas W. Lawson*, built of steel in 1902, as a seven-masted schooner.

Iron Hull Ships.—The first iron hull sailing vessel constructed in the United States was the schooner *Mahlon Betts* of 275 tons, built in 1854 at Wilmington, Del. Then there were none but wooden sailing vessels until the brig *Novelty* was built at Boston, Mass., in 1868, and the bark *Iron Age* constructed in 1869 for *Tupper & Beattie* of New York. The sloop yacht *Vindex* was then built in 1871 at Chester, Pa., by *Reanie Son and Archbold*; and in 1879 the yacht *Mischief* was built at Wilmington, Del. The three-masted schooner *Josephine* followed in 1880, being built by *William Cramp & Sons Co.* Then there came much larger vessels in

the *Tillie E. Starbuck*, built in 1883 by *John Roach & Son* at Chester, Pa.; and in the same year by *Gorringe & Co.*, as the American Ship-building Company, the *T. F. Oakes*. These vessels were about 2,000 tons register each. See also NAVAL CONSTRUCTION; SHIP-BUILDING.

J. H. MORRISON,

Author of 'History of American Steam Navigation.'

Sailor's Choice, the name of several excellent food fishes taken on the eastern and south-eastern coasts of the United States, which are of small size and belong to the family of grunts. The best known, probably, is *Orthopristis chrysopterus*, also called pigfish, and especially common in the Gulf of Mexico, which is regarded as the best pan-fish of the region.

Sailor's Creek, Battle of, the last great battle of the Civil War in the East. Sheridan says that it was "one of the severest conflicts of the war . . . so overshadowed by the stirring events of the surrender, three days later, that the battle has never been accorded the prominence it deserves." When Gen. Lee abandoned Richmond and Petersburg on the night of 2 April 1865, he ordered the concentration of his army at Amelia Court House, about 30 miles west of Petersburg, and it had collected at that point by noon of the 5th. On the night of the 5th Sheridan's cavalry and the Second, Fifth, and Sixth corps of the Army of the Potomac were at or near Jetersville, under orders to march early next morning on Amelia Court House. Gen. Meade began the advance at 8:30 A.M., and when four miles out of Jetersville, Humphreys' Second corps, on the left, discovered that Lee was moving westward, passing by the flank of the Union army. The advance on Amelia Court House was suspended, and the army faced about; the Second corps was ordered to move on Deatonville; the Fifth through Painesville, on the right of the Second; and the Sixth through Jetersville to the left of the Second. Sheridan's cavalry moved on the extreme left parallel to the Confederate line of retreat, impeding the march of the column wherever practicable, but Longstreet's corps succeeded in reaching Rice's Station, on the Lynchburg road, where he awaited the corps of R. H. Anderson, Ewell, and John B. Gordon, the last-named commanding the rear-guard. The Second corps was checked at Flat Creek by the destruction of the bridge, but, soon repairing it, overtook Gordon and kept up a running fight with him for 14 miles, carrying several lightly intrenched positions, and capturing prisoners, colors, and wagons. The pursuit continued to Parkinson's Mill, on Sailor's Creek, where Gordon made a stand, but was soon driven across the creek, losing three guns, 13 colors, several hundred prisoners, and a large part of the trains of Lee's army. He attempted another stand beyond the creek, but fell back as Humphreys crossed, and marched for High Bridge. Pursuit ended at night. During the day the Second corps had captured 1,700 prisoners, four guns, 13 colors, and several hundred wagons and ambulances. While the Second corps was engaging Gordon, the Sixth corps, with the cavalry commands of Merritt and Crook, had come up some three miles to the left and overthrown the corps of R. H. Anderson and Ewell. Custer's division had interposed between Ewell and

SAILOR'S SNUG HARBOR—SAINT

Gordon, destroying 400 wagons and taking prisoners and 16 guns; and Crook, moving rapidly to the left, found R. H. Anderson's command posted on high ground behind breastworks running across the Rice's Station road, and sent a dismounted brigade to take possession of and form across the road, thus cutting Anderson off from Longstreet. Ewell now proposed to Anderson that they make their way through the woods, around Sheridan's left, and get to Longstreet; but before anything could be done both were attacked. The Sixth corps had opened its artillery upon Ewell's 3,600 men, to which there was no reply, as Ewell was without artillery; and about 5 P.M. two divisions advanced, crossed Sailor's Creek, and attacked Ewell, who made a most determined resistance and, massing his troops, broke the centre of the Union line, but was checked by the artillery-fire from beyond the creek. The two divisions of the Sixth corps—Seymour's and Wheaton's—wheeled to the left and right respectively, enveloping Ewell's flanks; Stagg's cavalry brigade charged his right; and at the same time Merritt's and Crook's cavalry charged and routed R. H. Anderson's 6,300 men, killing, wounding, and capturing about 2,600. Ewell, now completely cut off and surrounded, surrendered his entire command. About 250 men of Kershaw's division, serving with him, escaped. Seven general officers were included in the surrender. The total loss of Lee's army was not less than 8,000 men. The Union loss did not exceed 900. Longstreet, who had remained at Rice's Station during the day, waiting for Anderson, Ewell, and Gordon, to unite with him, marched as soon as night set in, with Fields', Heth's, and Wilcox's divisions, for Farmville. (See FARMVILLE AND HIGH BRIDGE.) Consult: 'Official Records,' Vol. XLVI.; Humphreys, 'The Virginia Campaign of 1864-5'; Walker, 'History of the Second Army Corps'; Grant, 'Personal Memoirs,' Vol. II.; Sheridan, 'Personal Memoirs,' Vol. II.

E. A. CARMAN.

Sailors' Snug Harbor, a home for aged sailors on Staten Island, N. Y., established by Captain Richard Randall in 1800. The home is under government supervision and is in charge of a naval commander.

Sainfoin, *sân'foin*, or **Asperset**, a leguminous plant (*Onobrychis sativa*), originating in the Mediterranean countries, but which has been cultivated for centuries. The stem is about two feet high, with pinnate leaves, composed of small leaflets; the pea-like flowers are rather large and of a showy pink color, and are disposed in short spikes, on long axillary peduncles. It is a nutritious fodder, well liked by live-stock, especially sheep, makes good hay, and will grow on light, warm, chalky soils, where other pasturage does not thrive; the roots are long-lived and are useful for binding light soils, while the foliage not only shades the pastures, but makes a good crop for plowing under. It is also recommended as a honey-producing plant for bee pastures.

Saint, a person eminent for piety and other virtues. In the books of Scripture, both the Old and the New Testament, the whole body of the faithful people are called saints (2 Chron. vi. 41; Ps. xxxi. 3; Hebr. xiii. 14, "Salute all the saints"; Eph. i. 1, "the saints at Ephesus.") It is customary to give the title

saint to all the apostles, evangelists and other holy persons, men and women, named in the New Testament, to most of the Fathers of the Church, to all the martyrs. In the Church of Rome the title of saint is formally and authoritatively bestowed on servants of God who in their lifetime were eminent for their Christian virtues and graces, and whose sanctity has been proved by miracles after their death (see CANONIZATION; BEATIFICATION); but thousands of saints are honored by that church, who lived in early times before the process of canonization was thought of. Intercession by the saints in heaven and Invocation of the Saints are articles of belief in the Catholic Church, Eastern and Western, as also in the schismatical eastern churches; but that doctrine is repudiated by all the Protestant churches. The teaching of the Church of Rome, as proclaimed by the Council of Trent, is that the saints reigning with Christ "offer to God their prayers on behalf of men"; that it is good and useful "to call upon them with supplication," and, in order to obtain benefits from God through Jesus Christ, "to have recourse to their prayers, help and aid": here the church's doctrine regarding both intercession and invocation of saints is defined. Catholic divines find full warrant for this belief in the Christian sacred books; for the doctrine of intercession, in 1 Cor. xii. 12, where the unity of the Christian society is enforced; in James v. 16, where the prayer of the righteous is lauded; in Eph. vi. 18, and 1 Tim. ii. 1, where Saint Paul sets such store on the prayers of his fellow Christians; and it is asked, Can it be that the souls which have gone to God no longer exercise this kind of charity for their brethren on earth? If Scripture were silent on this question, the practice of the Church in all ages would suffice to remove all doubt as to the Apostolic origin of the belief in the intercession of saints. For the doctrine of the invocation of saints, theologians quote the word of Jesus Christ, that the angels in heaven rejoice when a sinner repents of his sin (Luke xv. 7): it were superfluous to cite the usage of the Catholic Church regarding invocation of saints: it began with the beginning of Christianity itself.

Saint Agnes, Sisters of; S. Ann, Sisters of; S. Augustine, Sisters of; S. Benedict, Sisters of; S. Bridget, Sisters of; S. Charles Borromeo Congregation; S. Dominic, Sisters of; S. Francis Seraphicus, Poor Brothers of; S. Francis Sisterhood; S. Gabriel, Brothers of; S. Januarius, Order of; S. John of Jerusalem, Knights of; S. John the Baptist, Sisters of; S. John the Evangelist, Sisters of; S. John of God, Order of; S. John the Evangelist, Society of; S. Joseph Sisterhood; S. Joseph of Nazareth, Sisterhood of; S. Joseph, Order of; S. Margaret, Sisters of; S. Martha, Sister-Servants of; S. Mary, Sisters of; S. Mary and All Saints, Sisters of; S. Mary Sisterhood; Saint Maur, Congregation of; S. Monica, Sisters of; S. Patrick, Order of; S. Saviour, Sisters of; S. Vane, Congregation of; S. Viator, Clerics of; S. Vincent de Paul, Society of. See ORDERS, RELIGIOUS.

Saint Andrew, Order of; S. Benoit of Aviz, Order of; S. Catherine, Order of; S. Cecilia, Order of; S. Charles, Order of; S.

SAINT ALBANS — SAINT ANDREWS

Elizabeth, Order of; S. Faustin, Order of; S. Ferdinand, Military Order of; S. George, Order of; S. George Constantinian, Order of; S. Gregory the Great, Order of; S. Henry, Order of; S. Hermengild, Order of; S. Hubert, Order of; S. Isabelle, Order of; S. Lazare, Order of; S. Louis, Order of; S. Michael, Order of; S. Michael and S. George, Order of; S. Olaf, Order of; S. Sava, Order of; S. Stanislas, Order of; S. Stephen of Hungary, Order of; S. Sylvester, Order of; S. Vladimir, Order of. See **ORDERS, ROYAL**.

Saint Albans, *âl'banz*, England, in Hertfordshire, 20 miles northwest of London, an ancient borough and market-town, standing on a height above the river Ver. Its abbey is one of the most remarkable Christian temples in England. Only a gateway remains of the original abbey, built in 796, in honor of Saint Alban, the first British Christian martyr. The present abbey has been so often extended and altered that it represents in its architecture many styles and various epochs of history, from the time of the Romans to that of Henry VII. It has the form of a Latin cross, with a length of 547 feet, and breadth of 206 feet. Its tower has an elevation of 146 feet, crowned with battlements. Other churches are Saint Michael's 10th century; Saint Stephen's, with some good Norman features, and Saint Peter's, whose nave is of the Early Perpendicular. There is an Edward VI. grammar school, and of modern buildings those deserving notice are the corn exchange, court-house, prison, baths, and public library, besides benevolent institutions, including hospital and almshouses. The chief industries are silk manufacture, straw-plaiting, and there are breweries and iron foundries. Two battles were fought between the houses of York and Lancaster, near Saint Albans; in that of 1455 Richard, Duke of York, defeated Henry VI., and in 1461, Margaret of Anjou, defeated the army of York, commanded by Warwick. Southwest of the present city stood the ancient Verulamium, one of the oldest towns in Britain, on Watling Street. In the abbey the printing press was set up on which the first English translation of the Bible was printed. Nicholas Breakspear, the only English pope, was born near Saint Albans. Pop. about 17,000.

Saint Albans, Vt., city, county-seat of Franklin County; on the Central Vermont railroad; in the northwestern part of the State, about 60 miles north-northwest of Montpelier, the State capital, and three miles from Lake Champlain. It was settled in 1763 and chartered as a city in 1897. In 1864 the town was raided by a band of Confederates who entered the United States from Canada. In 1866 a number of Fenians who were planning an invasion of Canada, made Saint Albans their headquarters.

The city is on a plain about 390 feet above sea-level and 373 feet above lake-level. The scenery is most pleasing; to the east are the Green Mountains, and on the west may be seen the Adirondacks. The city is in an agricultural region in which considerable attention is given to dairying. The chief manufacturing establishments are creameries, railroad shops,

machine shops, and flour and grist mills. There are large shipments of farm and dairy products. Saint Albans contains the Warner Hospital, the Warner Home, Villa Barlow Convent, an academy; Saint Mary's Academy, public and parish elementary schools, and a public library. Pop. (1890) 7,771; (1900) 6,239. Since 1890 a part only of the town has been chartered as a city. The population is, according to the 1910 census, 6,381.

Saint Albans (Vt.), Confederate Raid on, a foray made 19 Oct. 1864, when Lieut. Bennett H. Young, with about 25 Confederates, nearly all of them escaped prisoners, armed with revolvers and carrying chemical preparations with which to set fire to town and farm-houses, crossed the Canada line into the town intending to burn it and rob the banks. Several citizens were killed or wounded, and three banks robbed of \$150,000. An attempt to burn the town failed because of the defective character of the chemical preparations. Young and his party remained in town less than an hour, when they rode back to Canada on horses they had seized. Pursuit was made by United States troops, who captured some of the men on Canadian soil and turned them over to the authorities, by whom they were released on the technical ground of want of jurisdiction.

Saint Andrews, *ân'drooz*, Scotland, an ancient city of Fifeshire, on the North Sea, 11 miles southeast of Dundee and 31 miles northeast of Edinburgh. It was created a royal burgh by David I. in 1140, and after having been an episcopal see became an archiepiscopal see in 1472; it was long the ecclesiastical capital of Scotland. The ruined cathedral was begun in 1160 and took 157 years to finish. The old castle, also in ruins, was founded about 1200, and rebuilt in the 14th century; in it James III. was born, Cardinal Beaton assassinated, and in front of it George Wishart was burned. Saint Andrews was a celebrated educational centre as early as 1120; its university, the first in Scotland, dates from 1411; it consists of the united colleges of Saint Salvador and Saint Leonard and the college of Saint Mary, both at Saint Andrews, and embraces also University College, Dundee, founded in 1880. The united college of Saint Salvador and Saint Leonard has a principal (also principal of the university) and 11 professors, and the college of Saint Mary has a principal and three professors. Degrees, open to women as well as men, are conferred in arts, divinity, science, medicine, and law, much as in the other Scottish universities; and the university also confers the diploma and title of L.L.A. (Lady Literate in Arts). The number of students is about 250. In connection with the university is a library containing about 100,000 printed volumes and 150 MSS. The university unites with that of Edinburgh in sending a member to Parliament. Madras College or Academy, founded by Dr. Bell of Madras, the principal secondary school of the place, provides accommodation for upward of 1,500 scholars. Saint Andrews is a popular watering place and summer resort, and the headquarters of Scottish golf, its links being famous. The manufacture of golf clubs and balls is a thriving industry.

SAINT ANDREW'S CROSS — SAINT AUGUSTINE

Saint Andrew's Cross. See CROSS.

Saint Angelo Castle, Rome, Italy, a famous fortress situated on the right bank of the Tiber in the northwestern part of the city, opposite the bridge of Saint Angelo, and a short distance from the main buildings of the Vatican. It was built by the Emperor Hadrian as a tomb for himself and his family. Originally it was a round stone tower covered with marble and surmounted by a number of statues, which, together with the marble covering, have disappeared, leaving the bare stone structure. When the Goths besieged Rome it was used as a fortress, and has served this purpose ever since, being held and garrisoned by the party in power in the city. Since the time of Innocent III. it has belonged to the popes, who strengthened the fortifications with outworks, and connected the castle with the Vatican by an underground passage.

Saint Arnaud, sãn-tãr-nõ, Jacques Leroy de, French soldier: b. Bordeaux, France, 20 Aug. 1796; d. at sea 29 Sept. 1854. He entered the French army in 1813, but in 1822-31 was engaged with the Greeks in their struggle for independence. He returned to the French army in 1831, and in 1837 he went to Algeria, where he rose to the rank of *maréchal-de-camp* in 1847, and general of division in 1851, in recognition of his successful warfare against the Kabyle tribes. He was appointed minister of war 26 Oct. 1851, was active in promoting the *coup d'état* of 2 December, and was made a marshal of France in that month. He was placed in command of the French forces in the Crimean war and co-operated with Lord Raglan at the battle of Alma, 20 Sept. 1854. Consult Duperré Sainte-Marie, 'M. le Général Leroy de Saint-Arnaud' (1852).

Saint Asaph, ăz'af, Wales, an episcopal city in the County of Flint, six miles southeast of Rhyl, occupies an eminence in the Vale of Clwyd, near the confluence of the Clwyd and Elwy. It is built irregularly and has a venerable appearance. The encampment, Bron-y-Wylva, on the brow of the hill, is supposed to have been occupied by Roman forces. The cathedral, a small plain structure, dating from 1284, has been restored several times. Its library contains some rare and valuable books. The bishop's palace is modern. The town has a grammar school, founded 1600, county offices, a union workhouse and almshouses. Pop. about 18,000.

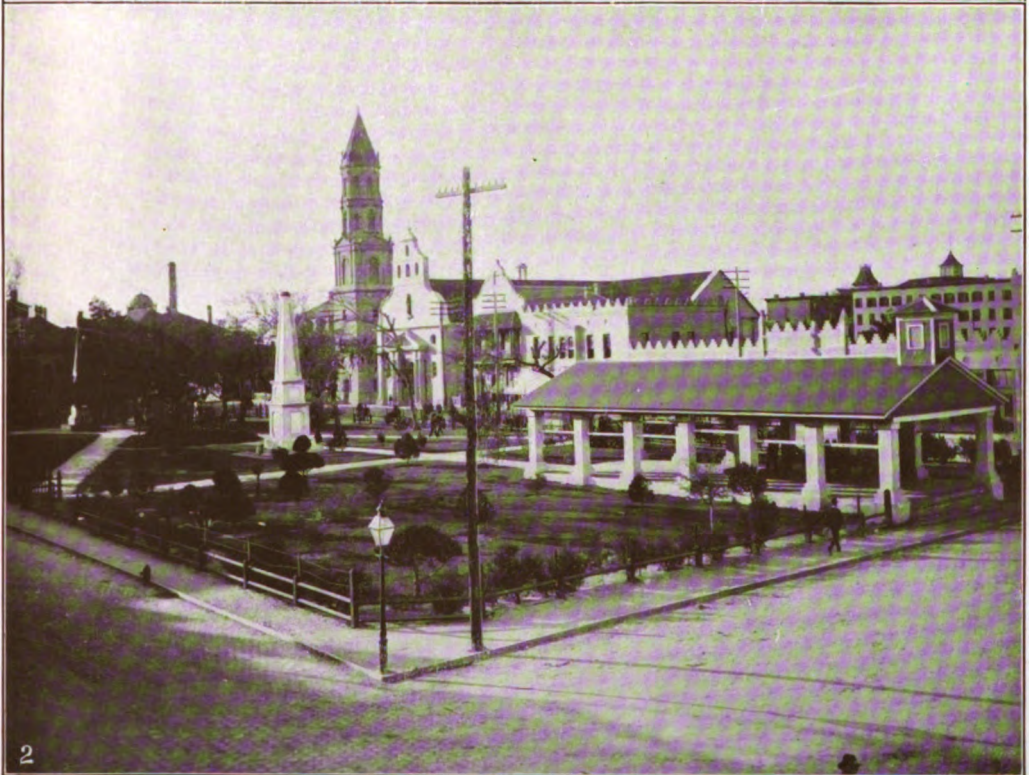
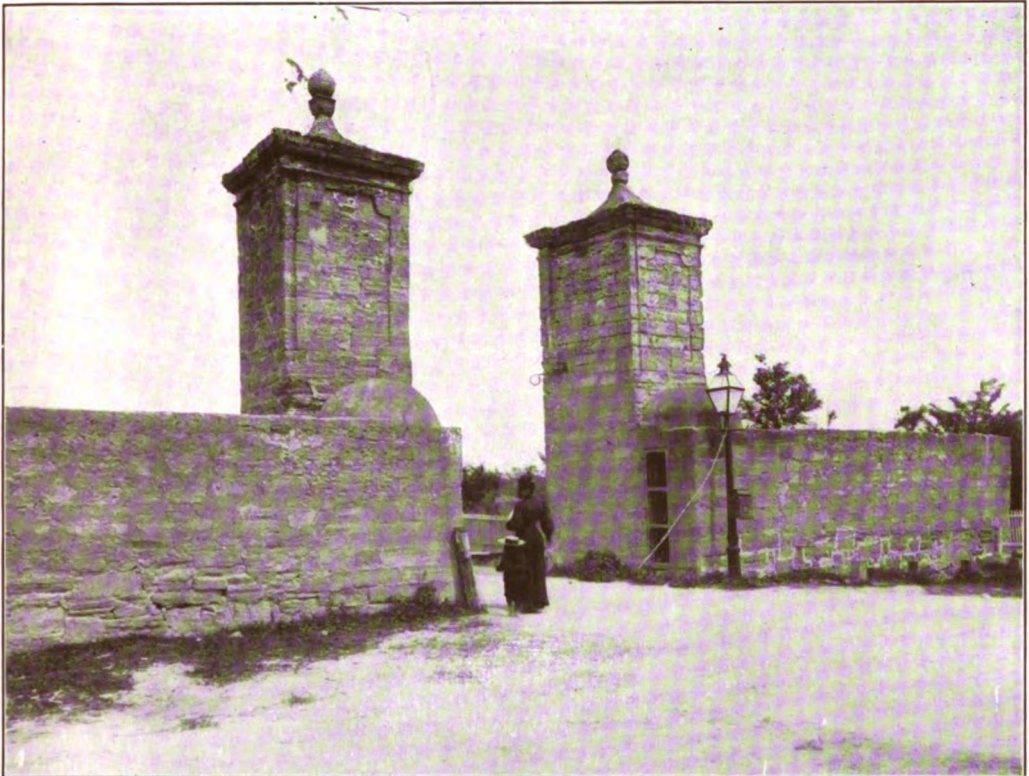
Saint Aubain, sãn-tõ-bãn, Nicolai de, Danish author, known largely by his pseudonym, 'KARL BERNHARD': b. Copenhagen 18 Nov. 1798; d. there 25 Nov. 1865. He first appeared in literature as a contributor to the 'Flyvende Post,' and finally obtained a large measure of success by his works of fiction, of which several dealt with higher Danish circles in modern times, while others were drawn from events of Danish history. Among the titles are: 'Lykkens Yndling' ('Fortune's Favorite'); 'Krøniker fra Christian den Andens Tid' ('Chronicles from the Time of Christian II.,' 1847), and 'Krøniker fra Erik of Pomerens Tid' ('Chronicles from the Time of Erik of Pomerania,' 1850). A collection of his writings appeared at Copenhagen in 1855-66 (2d ed. 1869-71).

Saint Aubyn, õ'bîn, Alan, pseudonym of FRANCES MARSHALL BRIDGES, English novelist: b. Surrey. She was the daughter of G. B. Bridges, a dramatist, and was married to Matthew Marshall of Saint Aubyns, Tiverton, Devonshire. Among her very numerous novels may be named 'The Master of St. Benedicts'; 'Broken Lights'; 'A Prick of Conscience'; 'The Junior Dean.' She has also written many juvenile tales such as 'Joseph and His Little Coat'; 'The Dean's Little Daughter'; 'Wapping Old Stairs.'

Saint Augustine, âgûs-tên or â-gûs'tên, Fla., city, port of entry, county-seat of Saint Johns County; on the Atlantic coast, about 38 miles south of the mouth of the Saint Johns River. The city is in lat. 29° 48' 30" N., and lon. 81° 35' W. It is on a peninsula formed by the Saint Sebastian River on the south and west and the Matanzas River on the east. It is on the Florida East Coast railroad. The city has many evidences of its ancient fortifications. The residence of the old Spanish governors is now a custom-house and post-office. The principal streets extend north and south. The main thoroughfare, Saint George Street, only 17 feet wide, extends through the centre of the city to the city gateway; but beyond this point it is called San Marco Avenue. Treasury Street, which crosses Saint George, is only seven feet wide at the east end. Of the modern buildings, the hotels are the most beautiful. The Ponce de Leon is of the style of the Spanish Renaissance; the buildings and furnishings cost about \$2,100,000. A pictorial history of Spanish adventure in the New World, especially relating to the history of Florida, is given in the mural decorations of the dining room and loggia.

Saint Augustine was settled 8 Sept. 1565 by Spaniards under Pedro Menéndez de Aviles; but the place had been visited as early as 1512 by Ponce de Leon. For two centuries it remained under Spanish rule, although in 1586 it was plundered by Drake. The population in 1763 was 3,000, besides the garrison of 2,500. It became a British possession in 1763 which it remained until 1783. During the Revolution it was an important military depot. It became again a Spanish possession in 1783 and in 1821 it was ceded to the United States (see FLORIDA). Some of the old buildings of the first Spanish régime are still in existence. The houses were then built chiefly of coquina, a formation found on Anastasia Island, a concrete made of broken shells cemented with shell-lime. The sea-wall, the city walls, and the fort were made of the same material. San Marco, now Fort Marion, is a fine specimen of the knowledge of military engineering of that age. The Government added a water battery in 1842-3, and has made occasional repairs, but it stands to-day about as when built by the Spaniards. It is said to have been built by Mexican convicts and Indian prisoners, and to have been in process of erection for about 100 years. The shaft of marble in the Plaza was erected in 1812-13 to commemorate the adoption of a Spanish constitution which was more liberal than the one under which the city had been governed. The inhabitants were ordered to destroy the shaft when the project failed, but the authorities only removed the tablets which have since been restored. A Roman Catholic Church begun in 1793 and used later as a cathedral, was burned in 1887; but the façade remained almost unin-

ST. AUGUSTINE.



1. The Old City Gate.

2. The Plaza.

SAINT BARTHOLOMEW—SAINT BRANDAN'S ISLE

jured. In rebuilding, this front wall was incorporated into the new structure; and the bell bearing the date of 1682 is also preserved. The only part of the old wall which now remains is the city gateway with about 30 feet of the wall on each side. The wall extended south along San Sebastian River, and from the river to the castle of San Marco (Fort Marion) where were a wall and moat. The old city extended nearly a mile, from the Castle of San Marco to the Franciscan Convent, now Saint Francis barracks, and the old sea-wall, built to protect the city from the sea, was also limited by the castle and the convent. The Government rebuilt the sea-wall in 1837-43, and there is now a granite coping three feet in width. For many years, until 1817, the entrance to the city from the mainland was by means of a drawbridge.

There are a number of manufacturing industries; chief among the establishments are the Florida East Coast railroad shops, which have about 200 employees; printing plant, 75 employees; lumber and wood works, 60. There are engaged in oyster canning and in fishing fully 250 persons. Saint Augustine is a famous winter resort; about 25,000 persons visit the city annually. Two fine hospitals, the Alicia and the Florida East Coast, several churches, and the municipal buildings are among the principal buildings. The educational institutions are Saint Joseph's Academy, Warden Academy (colored), three public schools (white), two parish schools (white), one parish school (colored), one kindergarten, and one of the 17 best libraries in the United States, entitled to all Government publications free, and a museum of natural history. The one bank has a capital of \$100,000; the annual amount of business is \$1,100,000. The government is vested in a mayor and a council of 10 members, five of whom are elected each year. Pop. (1910) 5,494.

D. E. THOMPSON,

General Manager *'The Evening Record.'*

Saint Bartholomew, bār-thōl'ō-mū, or **Saint Barthélemy**, sǎn bār-tāl-mē, West Indies, an island 190 miles east of Porto Rico. It is about eight square miles in extent, of irregular form, and mountainous. Although nearly treeless it is fertile; vegetables are cultivated in some of the valleys, and bananas, cassia, tamarinds, and sassafras are exported. Rocks and shallows make access to the island difficult for any but the larger coasting craft. Lead and zinc ores have been found in the island but are not worked. The principal town is Gustavia, near the port. The island belonged to Sweden, but in 1877 was sold to the French who had previously held it from 1648 to 1748; the people, who had retained French language and customs, desiring it. Slavery was abolished in 1848. Pop. 2,942.

Saint Bartholomew, Massacre of. See BARTHOLOMEW, SAINT, MASSACRE OF.

Saint Bede College, a Roman Catholic institution, in Peru, Ill., opened in 1891, and in charge of the Order of Saint Benedict. In 1902-3 there were connected with the school 18 professors and instructors, 194 students, of whom 174 were in the collegiate department. The courses are preparatory, commercial, and classical. The classical course is intended for those studying for the priesthood or for the professions.

Saint Benedict's College, located at Atchison, Kan. It was founded in 1858 by the Benedictine Fathers. There are two distinct courses offered, the classical and the commercial; the classical course leads to the degree of bachelor of arts, the degree of master of arts is conferred for two years' post-graduate study. The commercial course leads to the degree of master of accounts. There is also a preparatory course provided. There are two scholarships for those who enter the classical course. The college has two distinct libraries, one for the free use of the students, numbering 4,000 volumes in 1904, and one for the special use of the professors, numbering 15,000 volumes in 1904. The number of students in 1903-4 was 172, of members of the faculty, 24; the total number of graduates from the opening of the college to 1903 was 305.

Saint Bernard of Clairvaux. See BERNARD, SAINT.

Saint Bernard' Dog, a race of large dogs which gets its name from the Hospice of Saint Bernard, where it has long been kept by the monks to aid them in rescuing perishing travelers. This dog is very valuable in assisting the monks to keep to the line of the road and in finding their way back. They are seldom burdened. Dogs of other races are used for the same purpose in other parts of the Alps. The Saint Bernard dog is of two varieties: the first, which has long white hair with black or tawny spots being few in number. This famous dog, according to the traditions of the monastery, is the result of a cross between a Danish bull-bitch and a mastiff, a native hill dog, though at what time effected it is impossible to say. After the breed was once established it was kept pure till 1812. About 1860 these dogs first attracted the attention of English travelers, who imported them to Great Britain, where they were exhibited and at once excited much notice on account of their size and beauty. Others were introduced, and the Saint Bernard was soon established as the most popular big dog, a popularity which has gone on increasing. The Saint Bernard, as bred to modern English ideas, is an immense red or orange colored dog, marked with white on muzzle, neck, chest, feet, and tip of tail. The head should be massive and imposing, with a strong square muzzle, a point of great importance. Legs should be straight, with large feet, and double or, at least, single dew claws. Hind feet should turn out, though not sufficiently to hinder the dog's movements. The coat of the rough variety is of medium length; it should not be too curly. In the smooth variety the coat should be short and wiry. Many of the finest Saint Bernards measure over 30 inches high at the shoulder and weigh over 150 pounds. While most of these dogs are good-tempered, strangers should be cautious in dealing with them; they are very likely to attack and kill small pet dogs, especially fox-terriers.

Saint Bran'dan's Isle, a legendary island supposed to have existed to the southwest of the Canary Islands and to have been discovered by the Irish monk, Saint Brandan, and 75 brother monks in the 6th century, after seven years spent in search for the land of saints. This legend is traceable as far back as the 11th century. Each of the various early geographers gives it a different location. The legend had some influence upon the discovery of America.

Saint Catharines, Canada, county town of Lincoln County, Ontario, on the Welland Canal and on the Grand Trunk and Niagara, Saint C., and Tor. railways; 12 miles northwest of Niagara Falls, 32 miles east of Hamilton. Saint Catharines is noted for its mineral wells, has large hotels, and is in a picturesque and fertile region. It has important manufactures of agricultural implements, sewing machines, foundry products, saws, edge tools, furniture; flour, saw, and planing mills, ship yards, tanneries, woolen factories, and breweries. Saint Catharines also carries on an extensive fruit trade. It has good water and sewerage systems, gas and electric lights, banks, and newspapers. The more noted local institutions are Bishop Ridley College, a marine hospital, and a commercial college. Pop. about 10,000.

Saint Chamond, *săi shā-môn*, France, in the department of Loire, eight miles northeast of Saint Etienne by rail, at the confluence of the Gier and Janon, is a well-built manufacturing city. There are large coal mines in the vicinity, famous dye-works, and extensive metallurgical manufactures, and various other industrial works, including large mills for the manufacture of silk, lace, etc. The remains of a Roman aqueduct are found at Saint Chamond. Pop. about 17,000.

Saint Charles (Ark.), *Engagement at*, a battle of the Civil War, fought in Arkansas County on the White River, 17 June 1862. On 10 June Capt. C. H. Davis, then in command of the Federal Mississippi flotilla, received a request from Gen. Halleck to open up the White River for communication; he accordingly despatched a force under Commander Kilty, consisting of the ironclads Mound City and Saint Louis, and the wooden gunboats Lexington and Conestoga. Meanwhile the Confederates had fortified the bluffs at Saint Charles and, on learning of the approach of the Union vessels, had sunk their gunboat Maurepas across the channel and transferred her guns to the shore-battery. On 17 June a detachment of Federal troops landed below the bluffs, and the gunboats opened the attack upon the Confederate position, the Mound City leading; when she was within 600 yards of the shore a 42-pound shell entered her casemate and exploded her steam-drum; badly crippled she was towed out of action by the Conestoga, and the other boats continued the attack. The commanding officer of the land forces very shortly signaled them to stop firing, and the troops successfully stormed the Confederate battery. The Confederate loss was 6 killed, 1 wounded, and 8 missing; the most serious Federal loss was on the Mound City, the majority of her crew being killed by the escaping steam, or in consequence of jumping into the river. Of 175, only 3 officers and 22 men were saved. As there were no Confederate works farther up the river, this action gave control of the White River to the Federals. Consult: Mahan, 'The Gulf and Inland Waters,' p. 50; 'Battles and Leaders of the Civil War,' Vol. III., pp. 552-3.

Saint Charles, Mo., city, county-seat of Saint Charles County; on the Missouri River, 20 miles from its mouth, and on the Wabash, the Missouri, K. & T. R.R.'s; about 18 miles

northwest of Saint Louis. It was settled in 1765 by Blanchette "Chasseur," incorporated in 1795, and chartered as a city in 1805. There is an electric road connecting Saint Charles with Saint Louis. The city is in an agricultural region, in which the chief products are wheat and corn. The principal manufacturing establishments are car works in which there are 1,800 persons employed and flour mills. The city has large grain elevators, tobacco factories, and a foundry and machine shop. The principal public buildings are a court-house, 10 churches, the schools, and Saint Joseph's Hospital. The educational institutions are Sacred Heart Academy, opened in 1818; Saint Charles Military College, opened in 1838; Lindenwood College, opened in 1830; a high school, public and parish elementary schools, private schools, and four libraries. The three banks have a combined capital of \$150,000, and the annual amount of business is about \$1,400,000. The government is vested in a mayor and a council of eight members, elected biennially. Pop. (1890) 6,161; (1900) 7,982; (1910) 9,437.

PERCY ALEXANDER,
Editor 'Banner News.'

Saint Charles College, at Ellicott City, Md.; founded 11 July 1831, under the auspices of the Roman Catholic Church. The funds for the institution were donated by Charles Carroll of Carrollton, one of the signers of the Declaration of Independence, who gave 253 acres of land from his own domain, and \$5,349 in money. The charter of the school as agreed upon by Archbishop Maréchal of Baltimore and Charles Carroll, stipulated that the purpose of the school was "the education of pious young men of the Catholic persuasion for the ministry of the gospel," and that the legal administration of the college should be entrusted to five trustees, who must be citizens of the United States. The founder also requested that the trustees be members of the Society of Saint Sulpice. The school was not opened until October 1848. The faculty then consisted of the president, one assistant and four students. At the present date (1903) the faculty numbers 15, the students 230. The total number that have matriculated is 3,367; and about 1,167 have been ordained priests. The grounds have been improved and a number of fine buildings supply all needful space. Saint Charles College forms the classical department of Saint Mary's University and Theological Seminary of Saint Sulpice, at Baltimore. The course including the preparatory work is six years. The college has power to grant degrees. There are three libraries; the main one has about 16,000 volumes; the library connected with the reading room has 5,000 volumes, and the library for the Juniors is in their own part of the college. Several scholarships are available on competitive examination.

Saint Chris'topher, popularly **Saint Kitts**, West Indies, 45 miles northwest of Guadeloupe, is an island belonging to the Leeward group, and a British possession. Its area is 68 square miles; its length 23 miles, breadth five miles. It is traversed by a rugged range whose highest summit, Mount Misery, has an altitude of 4,100 feet. Basse-Terre, the capital, on the coast, has a population of about 7,000. It is united administratively with Nevis, and the small island Anguila. The chief products are sugar, mo-

lasses, rum, salt, some coffee, tobacco, and cattle. The island was discovered in 1493 by Columbus; colonized by the French and British simultaneously in 1625, and held by those nations alternately for some time, passing over entirely to England in 1713.

Saint Clair, Arthur, American soldier: b. Edinburgh, Scotland, 1734; d. Greensburg, Pa., 31 Aug. 1818. He was a grandson of the Earl of Roslyn and was educated at the University of Edinburgh, after which he studied medicine. He came to America with the fleet of Admiral Boscawin and took part in the capture of Louisburg and of Quebec. In 1762 he resigned his commission of lieutenant and two years later established a home and a manufacturing industry in Ligonier Valley, Pa. He became prominent in his vicinity and held several civil offices. In 1775 he was made colonel of militia; and on 9 Aug. 1776 was appointed brigadier-general and was ordered by Washington to organize the New Jersey militia. He fought at Trenton and Princeton, and having been appointed major-general in 1777, succeeded General Gates in command at Ticonderoga. At the approach of Burgoyne, with a force more than three times outnumbering his, he evacuated the fort on account of his inability to protect all the exposed points. A part of his force was attacked and defeated at Hubbardton. For this disaster he was tried in court-martial in 1778, but acquitted of the charges brought against him. He commanded a body of troops in 1781-2 under General Greene in the South; was a delegate to the Continental Congress in 1785-7 and its president in 1787. He was appointed first governor of the Northwest Territory in 1789, and was appointed commander-in-chief of the forces engaged in warfare with the Indians in 1791, but was defeated on 4 November, near the Miami villages. In March of the following year he resigned his commission and in 1802 President Jefferson relieved him of the governorship of the territory. He published a narrative of the manner in which the campaign against the Indians in the year 1791 was conducted under the command of Maj.-Gen. St. Clair with his observations on the statements of the Secretary of War (1812). Consult: W. H. Smith, 'The Life and Public Services of Arthur St. Clair' (1882).

Saint Clair, Mich., city in Saint Clair County; on Saint Clair River at the mouth of the Pine River, and on the Michigan Central railroad; about 43 miles northeast of Detroit and 12 miles south of Port Huron. A ferry connects the city with Courtwright on the Canadian side of the river. It is in an agricultural region and has considerable manufacturing interests. The chief industrial establishments are lumber mills, sash, door, and blind factories, ship-yards, salt works, brick works, iron works, foundry, tannery, and brewery. There is a good system of waterworks, several well built churches and schools. Pop. (1890) 2,353; (1900) 2,543; (1910 est.) 2,670.

Saint Clair, Pa., borough in Schuylkill County; on Mill Creek, and on the Philadelphia & Reading railroad; five miles north of Pottsville. An electric railroad connects the borough with Pottsville. It is in an anthracite region, and the chief industries are connected

with mining and shipping shops, a foundry, a tool brick yards, and a large works. There are a high parish schools, a private There is a large trade 3,680; (1900) 4,638; (1910

Saint Clair, a lake between Michigan and Canada Huron and Lake Erie. It is about north to south; its maximum and the average width 12 miles. It is about 3 feet Erie and 5.4 feet lower than northern part is shallow, from Saint Clair River; the central part is 19 feet with a blue mud, with salt parts, all supporting a vegetation in which are life. The lake is noted for steamers and the enormous carries each year.

Saint Clair, a river, in honor of Patri officer, who in 1765 purchased a tract of land along the outlet of Lake Huron, and by several channels into a delta at the mouth is known as the Flats. A number of sunbaths have been built on the channels has been improved canal about one and one mile long, and of such a width as to admit large lake steamers. The river connects the United States with St. Clair. It is nearly two miles long and was opened for travel in 1824. It is about 41 miles long.

Saint Cloud, *sân-kloo*, a town in the department of Seine-et-Oise, France, seven miles west of Paris, situated and especially interesting for its historical associations. It comes from the name of Paris, and the beautiful chateau and elegant fountain are sort of Parisians. Within the town of Saint Cloud are situated the porcelain manufactory. It was founded by Gondy in 1572, purchased by Orléans, the brother of Louis XIV. in 1658, and by Louis XV. in 1762. Henry IV. in the old mansion by Catherine de Medici. Peter the Great was received here in 1717. Brumaire, and his favor caused himself to be decorated here. Blücher had his headquarters here in 1806. Saint Cloud, Charles X. (1824) to the ordinances which Napoleon III. signed here to declare war against Prussia (1870).

Saint Cloud, *klowd*, a town in Stearns County, Minn., on the North

SAINT CROIX — SAINT DIZIER

N. R.R.'s; about 65 miles north of Minneapolis, two miles below the mouth of the Sauk River. It was settled in 1852 by Ole Bergeson, incorporated in March 1856, and became a city in 1868. In the vicinity are extensive granite quarries. The city has good water-power and a number of manufactories. There is a large surrounding region in which are productive farms. The chief manufacturing establishments are flour mills, foundries, machine shops, wood working factories and railroad shops. There are large grain elevators, stock yards, and several well built business houses. There is considerable trade in granite, farm products, flour and wood work.

Saint Cloud has the Minnesota State Reformatory Prison, Saint Raphael's Hospital, and Saint Joseph's Home for the Aged. The educational institutions are a State normal school, Saint Clotilde's Academy of Music, five public schools, three Roman Catholic parish schools, and a library. The five banks have a capital of \$300,000. The government is vested in a mayor and a council of 15 members, three of whom are elected each year. Pop. (1890) 7,686; (1900) 8,663; (1910) 10,600.

C. F. MACDONALD,
Editor 'Daily Times.'

Saint Croix (sometimes called **SCHOODIC**), (1) a river, the outlet of Grand Lake, flows south, east-southeast, and forms part of the boundary between Maine and New Brunswick. It flows into Passamaquoddy Bay. It is 75 miles long; navigable as far as Calais, Maine, above which there is extensive waterpower. (2) A river which has its rise in Douglas County, Wis., flows southwest to the Minnesota border, then south, forming the boundary between Wisconsin and Minnesota for a distance of about 100 miles, entering Mississippi River at Prescott, Wis. It is about 150 miles long and navigable to the Falls or the Dalles, a distance of 54 miles from its mouth. At the Falls there is a descent of 50 feet in 900 feet, and below there is a cañon.

Saint-Cyr, Laurent Gouvion, lă-rôn goo-vê-ôn sãn sêr, MARQUIS DE, marshal of France: b. Toul, France, 13 April 1764; d. Hyères, France, 17 March 1830. In 1792 he entered the army and attached to the staff of General Custine. He was rapidly promoted and in 1796 commanded the centre division in the army on the Rhine under Moreau. He was appointed to the command of the army of Italy in 1798 where he re-established discipline, the army having been on the verge of revolt against their general, Masséna. He returned to the army of Moreau in 1799, was victorious at Biberach in 1800, and in 1801 was sent to Spain to command the army which was to invade Portugal. After the treaty of peace was signed he became ambassador at Madrid. He participated in the Prussian and Polish campaigns of 1807, and in 1808 was in command in Catalonia, where he relieved Barcelona. In 1811 he was assigned to the command of a corps in the Russian campaign. He was victorious at Polosk in 1812 and was created marshal of France in recognition of his services. He made a brilliant fight at Dresden, but was forced to capitulate and remained a prisoner in Hungary for some time. After the Restoration he was created a peer of France, was appointed minister of war in 1815, minister of marine in 1817 and a few months

later minister of war again, retiring in 1819. He wrote: 'Journal des Opérations de l'Armée de Catalogne en 1808 et 1809' (1821); 'Mémoires' (1829-31); etc. Consult De Vernon, 'Vie de Maréchal Gouvion Saint-Cyr' (1857).

Saint Cyr, or **Saint Cyr-l'Ecole**, lă-kol, France, a village near Paris, west of Versailles, at the end of the old park of Louis XIV., celebrated for its military school. Madame de Maintenon founded here (1686) a seminary for the education of the daughters of families of high rank in reduced circumstances. The convent chapel contained the tomb of Madame de Maintenon, and Racine's 'Esther' and 'Athalie' were written for the pupils of the school and first acted there. During the Revolution this institution was abolished, and in 1806 Napoleon transferred to Saint Cyr the famous military academy which he had founded at Fontainebleau. Two advanced forts of the new enceinte around Paris are situated at Saint Cyr. Pop. 2,835.

Saint Denis, sãn dê-nê, France, in the department of Seine, 4½ miles north of Paris, is an important junction on the Northern railroad. The town is especially celebrated for its venerable abbey, from which it derives its name; the two high towers are respectively Romanesque and Gothic; the rose window dates from the 13th century. The abbey was the burial place of the kings of France and in the chapels of the nave are the tombs of Louis XII., and Anne of Brittany (1591); of Henry II.; Catharine de' Medicis; of Louis of Orleans; of Francis I.; and Claude of France—one of the splendid tombs of the Renaissance; and that of Dagobert, one of the most curious of mediæval (13th century) works of art. The crypt dates partly from the time of Charlemagne. In the centre is the vault, where the last king reposes—Louis XVIII., the only one whose ashes have been respected. The crypt also contains the Bourbon vault, where repose Louis XVI. and Marie Antoinette. Modern features deserving notice are an orphanage (1886), the monument commemorative of the Revolution and other public statues, and the railway station. In 1888 the old Hotel Dieu was converted into a hospital for old men.

Saint-Denis, the capital of the French island of Réunion in the Indian Ocean, on the north coast of the island. It is built on a long, narrow beach shut off on the land side by a range of high volcanic mountains. In the city are a cathedral, a palace for the governor, a theatre, and a large number of educational institutions, including a lyceum, several large schools, a library, a museum, and a botanical garden. The harbor is an open roadstead exposed to frequent severe storms, but a new, protected harbor has been constructed at Pointe des Gallets, a few miles to the west, which is connected with the city by a railroad. Pop. about 35,000, chiefly French creoles.

Saint Dizier, sãn dê-zê-ă (ancient **DESIDERII FANUM**), France, department of Haute-Marne, on the Marne, 35 miles southeast of Châlons. Part of the old castle is standing and the church has some peculiar Gothic windows. There is a library and a museum. It is an important centre of the iron trade, with foundries of iron, steel, copper and bronze, engineering works,



THE PURITAN, by Saint-Gaudens

SAINT ELIAS—SAINT GALL

etc. It is a railway station. In 1544 Saint Dizier was besieged and taken by Charles V., although strongly fortified. In 1814 there was severe fighting nearby, between Napoleon and the Allies. The walls have been razed and the site now constitutes the promenade of the town. Pop. about 15,000.

Saint Eli'as, Mount, in Alaska, in the southeastern part of the Territory; lon. 140° 55' 47.3" W.; lat. 60° 17' 35.1" N. The United States Coast and Geodetic Survey report the height 18,100 feet above sea-level. It rises from an elevation of considerable height, and the foot-hills on the south side are covered with trees. The timber line is from 2,000 to 2,500 feet above sea-level. The mountain itself is covered with snow and ice and has many glaciers. The south side is almost perpendicular; the storms of ages and the avalanches have removed many of its rugged features. The north side is more accessible, and has been explored to some extent. The Malaspina Glacier (area 1,500 square miles) is at the foot of Mount Saint Elias, near Yakutat Bay.

Saint Elmo Castle, Naples, Italy, a fortress crowning a rocky hill on the western outskirts of the city. It was built by Robert the Wise in 1343. It has massive walls surrounded by fosses cut out of the solid rock, and was long held to be impregnable. It is now used as a military prison.

Saint Elmo's Fire. See **ELMO'S FIRE, SAINT**.

Saint Etienne, sǎn tǎ-tē-ēn, France, a manufacturing town in the department of the Loire, on the Furens, 32 miles southwest of Lyons. It is located amid some of the richest coal fields of France. The important buildings include the old abbey of Valbenoite, dating partly from the 13th century, a Protestant church, a synagogue, a town house, a school of mines with fine collections, and an art palace, with a museum and library, rich in old MSS., collections of natural history, and of ancient artillery. The enormous metallurgical establishments yield one third of the whole French production of steel, manufactured according to the Bessemer and Martin processes, the national gun factory and other metal works; the manufacture of hemp cables, pottery and lime, the weaving of ribbon, laces, trimmings, etc., and conditioning of silk are among the varied and active industries of the town, giving employment to thousands of men and women. The collieries are very extensive, employing alone 15,000 miners, while 80,000 work in the ribbon factories, 16,000 work in heavy iron goods, hardware 7,000, military and naval material, etc., 6,000.

Saint Eustatius, ū-stǎ'shī-ūs, or **Saint Eustache**, sǎn-tē-stǎsh, an island of the Dutch West Indies, lying south-southeast of Porto Rico, 12 miles northwest of Saint Christopher. It consists of two volcanoes with an intervening valley, and covers an area of eight square miles. Sugar, cotton, maize, yams, potatoes, and above all tobacco are cultivated. Yarns and sweet potatoes are exported. The only landing is protected by two forts. The Dutch acquired the island in 1600, colonizing it in 1635. It suffered many vicissitudes at various periods under English and French occupation, but in 1814 was finally restored to the Dutch. Orange-

town is the only town. Earthquakes are frequent. It has a salubrious climate. Pop. about 2,000, mostly negroes.

Saint-Evremond, sǎn-tǎvr-môn, **Charles de Marguetel de Saint Denis**, French courtier and author: b. Saint Denis du Guast 1 April 1613; d. England 20 Sept. 1703. He was educated by the Jesuits, entered the army about 1629 and served in the Thirty Years' war. He was a witty and accomplished courtier, and was for a time a favorite with Condé and also with the king; but incurred their displeasure by his sarcastic raillery and especially by his letter on the Peace of the Pyrenees. In 1662 he went to England, where he became a favorite at court and received a pension of £300 (\$1,500) from Charles II. He wrote dramas, essays and letters, his collected works being published in 1705. These include 'Sir Politics,' written with Buckingham.

Saint Fran'cis, a river which rises in eastern Missouri and flows into the Mississippi River in Arkansas, lat. 34° 45' N. It is a large river, and was formerly navigable 300 miles for large keel boats; but the earthquakes of 1811-12 raised its channel so much, and so irregularly, as to cause the waters to overflow the banks and form a vast number of lakes and swamps along its former course. At high water the river is still navigable at some seasons of the year for about 150 miles; and there are several settlements about 70 miles from its mouth. Its waters abound with excellent fish. Length, about 450 miles.

Saint Francis Xavier College, located in New York. It was founded in 1847 by the Jesuits, and was granted the powers of a university in 1861 by the State board of regents. Its organization includes a collegiate and a preparatory department. The regular college course leads to the degree of A.B.; it includes instruction in logic, metaphysics, and theodicy, English and the classics, mathematics and science, and history. Post-graduate work in literature, history, sociology and psychology is provided for, and leads to the degree of A.M. There are 46 scholarships. The college is well equipped; the library in 1904 contained 101,000 volumes, and the grounds and buildings were valued at over \$750,000. The students in 1903-4 numbered 562, a large majority being in the preparatory department, and the faculty 33.

Saint Gall, gāl, Switzerland, (1) capital of the Canton of Saint Gall, on the Steinach, in a high, narrow valley, about 50 miles from Zürich. It is the see of a bishop, and has besides the cathedral, several churches, a monastery, now containing public offices, a large town-house, library, and orphan asylum. The town library is rich in works relating to the Reformation. The ancient Benedictine Abbey was famous as an asylum of learning during the Dark Ages, and was one of the most celebrated educational institutions of Europe. Several of the classics, namely, Quintilian, Silicus, Italicus, and Ammianus Marcellinus, were solely preserved among its MSS. Notker and Ekkehard were among its pupils. Saint Gall is an important manufacturing centre, celebrated for its fine laces and embroideries.

(2) The Canton covers an area of about 780

square miles. It has a diversified surface; the southern and central portions are covered by lofty Alpine ranges. Its principal lake is the Wallenstadersee. The climate of the valley is mild, but in the mountainous district is rigorous. There are important stone quarries, much wood and good pastures; on the lower slopes vineyards and orchards, and some arable lands. Manufactures consist of cotton and linen goods. The constitution is preeminently democratic. German is the language spoken. Pop. about 255,000.

Saint Gaudens, gá'dénz, Augustus, American sculptor: b. Dublin, Ireland, 1 March 1848; d. Cornish, N. H., 3 Aug. 1907. He was brought to the United States in infancy and at 13 was bound in apprenticeship to learn cameo-cutting and spent several years at this art. Six years later (1867) he went to Paris and studied under the sculptor Jouffroy at the Ecole des Beaux Arts. While at Rome in 1871 he produced his first figure, 'Hiawatha,' and the following year returned to the United States. The Sherman equestrian statue which was unveiled at the southeast entrance of Central Park in 1904 is the last of a series of five in which are commemorated heroes of the Civil War, among the most notable of which is the remarkable statue of Farragut in Madison Square, New York. Saint Gaudens was a sculptor of originality and freshness, who had adopted the best standards of French taste and method of execution without being hidebound by tradition; he had a style at once polished and free. Among his other works are the 'President Lincoln' statue in Lincoln Park, Chicago; the bas-relief 'Adoration of the Cross by Angels'; the 'Shaw Monument' at Boston; and the 'Diana' on the tower of Madison Square Garden, New York. He also took part in executing the 'Parnell Memorial' monument in 1901, designed several medals of presentation authorized by Congress, and assisted John La Farge in decorating Trinity Church, Boston.

What perhaps is the most striking characteristic of all his ideal statues is that of 'The Puritan' (at Springfield, Mass.). This is the puritan of earlier New England in all his aggressive and unbending strength—soldier, theologian, statesman. There is nothing winning or conciliating in his air. He is come to conquer the wilderness as Cromwell conquered the aristocracy of England and wiped out for the brief period of the Commonwealth the haughtiest of European dynasties. The puritan, as Saint Gaudens has portrayed him, carries the Bible next his heart in one hand and a stout cudgel of oak in the other. He personifies those unswerving, and sometimes fanatic principles on which the ancient commonwealths of New England were established. Of the Sherman monument, executed by Gaudens, a critic had said: 'The composition of the Sherman is his own, and it has the spontaneity and the balance of a work evolved straight from a powerful imagination and an original mind. The Victory is exactly where it belongs, and bears a relation as true, as unforced, as anything in nature itself to the horseman pressing close upon its flying robe. Once more a word on the sculptor's discretion is inevitable. He wanted to express movement in this monument, to give to Vic-

tory almost aerial lightness in her carriage, to embody in the horse a type of great strength, pushing its way to the front, and to make Sherman himself the very ideal of a leader, who spurns the miles behind him. The bronze seems almost sentient. The group quivers with vitality. But the rhythm of this dramatic conception is held so well in hand, it is so majestic, that classic art itself could not produce a more nobly monumental effect.'

Saint George and the Dragon. See DRAGON.

Saint George, Cape, Newfoundland, the westernmost projection of the island, forming the northwestern extremity of Saint George Bay, on the Gulf of Saint Lawrence.

Saint George's Channel, an arm of the Atlantic which separates Ireland from England. At the north it unites with the Irish Sea. Its entire length from southwest to northeast is about 210 miles. The tide rises in this channel about the same time as in the English Channel, so that there is high water simultaneously at Brest in France, Falmouth in England, and Cape Clear in Ireland.

Saint George's Chapel, Windsor, England. See WINDSOR CASTLE.

Saint Germain, sǎn-zhèr-mǎn, COUNT OF, adventurer of the 18th century: b. perhaps 1710; d. Eckernförde, Schleswig, 1784. A mystery enveloped his birth and origin, of which he took every advantage. He spoke English, German, Italian, Spanish, and Portuguese to perfection, and French with a slight Piedmontese accent; and was variously thought to be the son of a tax collector at San Germano, Savoy, an Alsatian Jew, a Portuguese marquis named Betmar, or the illicit offspring of a Spanish princess. After sojourning in various cities of Italy under as many pseudonyms, he lived from 1750 to 1760 at the French court under the patronage of Marshal de Belle-Isle, and, having a fine personal appearance and address, considerable erudition, and a wonderful memory, became a favorite of Mme. de Pompadour and the king. He was reported to be from 2,000 to 3,000 years old. Frederick the Great, having asked Voltaire for some particulars respecting this mysterious person, was told that he was "a man who never dies and who knows every thing." He passed the last years of his life at the court of the prince of Hesse-Cassel, and is supposed to have been employed during the greater part of his life as a spy at the courts at which he resided. Cagliostro owned himself a pupil of the Count of Saint Germain. Consult: Oettinger, 'Graf Saint Germain' (1846).

Saint Germain-en-Laye, òn lǎ, France, a town in the department of Seine-et-Oise, on a height bordering the Seine, nine miles west of Paris. At the edge of a forest, 200 feet above the river, the air is bracing and salubrious. It is a favorite summer resort and residence of Parisians. The terrace of Saint Germain is one of the finest promenades in Europe and commands an extensive view of the valley of the Seine and surrounding hills. The ancient castle of the town now serves as a museum of antiquities; it was destroyed and restored at various epochs. In the Henry IV. pavilion Thiers died (1877). The old castle was first built by Charles V.

(1370), and reconstructed and embellished by many succeeding sovereigns, especially Louis XIV. Here were born Charles IX., Margaret of Navarre, Henry II., and Louis XIV. James II. of England and most of his family here lived and died as exiles. It now serves as barracks and a military prison. Saint Germain is the seat of one of the cavalry garrisons which surround Paris; at a short distance is the Convent des Loges, connected with the Legion of Honor (Saint Denis).

Saint Germain de Rimouski. See RIMOUSKI.

Saint Gotthard, göth'ard, Switzerland, a mountain group on the confines of the cantons Uri, Grisons, Ticino, and Valais, belonging to the Lepontine or Helvetian Alps, which it connects with the Bernese Alps. It forms a kind of central nucleus in the great watershed of Europe; each of its slopes giving rise to an important river — the north to the Reuss, the south to the Ticino, the west to the Rhône, and the east to the Rhine; all these rivers rise within a circuit of 10 miles from its centre. The culminating point has a height of 10,600 feet, and three other summits are beyond the limit of perpetual snow. The Col of Saint Gotthard, at its summit level, where the Hospice stands, is 6,808 feet high. A bridle path over the pass had existed since the 6th century and over it an excellent carriage road was completed in 1832, in which, particularly on the Italian side, formidable difficulties were surmounted, and much engineering skill displayed. A railway tunnel pierces this mountain group between Göschenen on the north and Airolo on the south, thus directly connecting the railway system of North Italy with those of Switzerland and Western and Central Germany. This tunnel is the longest in the world, being 16,295 yards, or rather more than 9¼ miles long. Its construction, begun in 1872, was completed in 1881, and it was opened for traffic early in 1882. Its total cost was about \$45,400,000, defrayed by Swiss, German, and Italian state subventions, by mortgages and shares. The excavation was carried on simultaneously on the Italian and the Swiss side, the workmen finally meeting in the middle, where the height above sea-level is 3,785 feet.

Saint Gregory. See GREGORY, SAINT.

Saint Helena, hē-lē'nā, an island in the Atlantic, belonging to Great Britain, 700 miles southeast of the island of Ascension, the nearest land. The area is about 47 square miles. Although isolated as relates to its contiguity to the mainland, it is in the direct line of ocean communication via the Cape of Good Hope, many vessels making it a halting station. It is an extinct volcano whose crater forms the main ridge. Many gorges, some of which are 1,000 feet deep, converge from the walls of the crater in all directions and numerous caves have been formed. High cliffs extend all around its shores to the water's edge, and there is a good harbor.

The fauna and flora are deeply interesting, many specimens being peculiar to the island. Farm and garden produce constitute the entire wealth of the colony; Jamestown (3,000 inhabitants) is the only town. Longwood, where Napoleon died, is a farm-house, standing on a high plain. The Portuguese discovered the is-

land, subsequently the I and later it was ceded chief interest consists in Napoleon's captivity.

Saint Hel'ens, Engli miles northeast of Liverpool and parliamentary borough. A town hall (1875-6), (1896), churches, schools, asylum and hospitals, and recreation grounds features. The town owes coal-beds in the environs, copper-smelting, the man steel, chemical and lead v eries and other industries.

Saint Helens, a volcano cade Range, in the State 46° 12' N., lon. 122° 4' W at the base and beyond is mountain has all the app volcano. Height, 9,750 feet Rainier in its treeless summit, but it is smaller. the base, is Spirit Lake.

Saint Helier, hēl'yē capital of the Island of European summer resort Saint Aubin's Bay, on t strongly fortified and d Castle (1551-86), on a r with the mainland by a c Regent, an imposing citade The principal buildings are Maison Saint Louis or Jes house; public library, tow man parish church, and Catholic cathedral. Fine and marine drive four mil bay, and extensive and v prominent features. Th trade with England, Franc potatoes, and cattle. Pop.

Saint Henri, or Tan an incorporated city of He bec, suburban to Montreal is a busy industrial centre and has a station on the (Cotton, leather, confection and machinery are among factures.

Saint Hilaire, sān-tē-lī César, called Auguste Pr naturalist and traveler: b. d. there 30 Sept. 1853. A set out in 1816 on a long j carrying his explorations known, and returning in t lections. In 1830 he was Academy of Sciences; subs professor of botany in the Paris. He made several d value, and published three 'Voyage dans la Province Minàs Gerães' (1830); 'trict des Diamants et sur (1833); 'Voyage aux Sou et dans la Province de C sides 'Flora Brasiliæ Jussieu and Cambessèdes 1 Botanique' (1840-1).





